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Introduction

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The Preliminary Edition of the *NASA Thesaurus* (December 1967) (NASA SP-7030) is used as the authority for the indexing vocabulary that appears in the subject index to this issue. The terminology has been modified from the *Guide to the Subject Indexes for STAR* (NASA SP-7016), the authority used for the vocabulary to indexes published prior to 1968. The *NASA Thesaurus* should be consulted in examining the current indexing vocabulary, including associated cross reference structure. Only the subject terms that have been selected to describe the documents abstracted in this issue appear in the subject index. Copies of the *NASA Thesaurus* may be obtained from the Clearinghouse for Federal Scientific and Technical Information or the U. S. Government Printing Office at $8.50 for the three-volume set.

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Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics. **3000**

03 AUXILIARY SYSTEMS
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Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology. **3007**

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Includes communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation. **3032**

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Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations. **3054**

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Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion. **3057**

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Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences. **3065**

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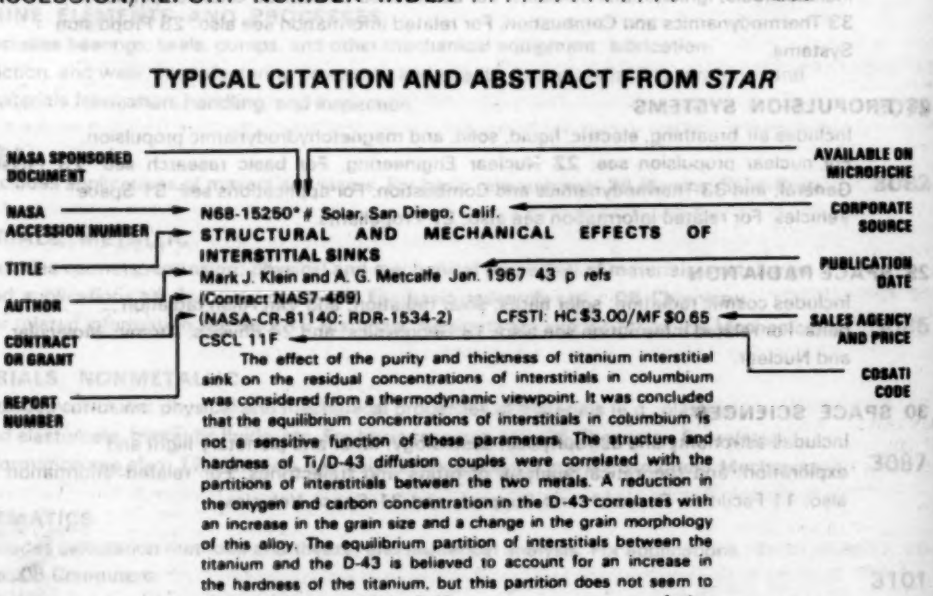
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N68-15250* # Solar, San Diego, Calif.
STRUCTURAL AND MECHANICAL EFFECTS OF INTERSTITIAL SINKS
Mark J. Klein and A. G. Metcalfe Jan. 1967 43 p refs
(Contract NAS7-469)
(NASA-CR-81140; RDR-1534-2) CFSTI: HC $3.00/MF $0.65
CSCL 11F
The effect of the purity and thickness of titanium interstitial sink on the residual concentrations of interstitials in columbium was considered from a thermodynamic viewpoint. It was concluded that the equilibrium concentrations of interstitials in columbium is not a sensitive function of these parameters. The structure and hardness of Ti/D-43 diffusion couples were correlated with the partitions of interstitials between the two metals. A reduction in the oxygen and carbon concentration in the D-43 correlates with an increase in the grain size and a change in the grain morphology of this alloy. The equilibrium partition of interstitials between the titanium and the D-43 is believed to account for an increase in the hardness of the titanium, but this partition does not seem to affect the hardness of the D-43.
Author

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Scientific and Technical Aerospace Reports

A Semimonthly Publication of the National Aeronautics and Space Administration

01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbo machinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

N68-29623# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INVESTIGATION OF SHORT SUPERSONIC NOZZLES [ISSVEDOVANIYE KOROTKIKH SVERKHZVUKOVYKH SOPEL]

L. V. Gogish 1 Aug. 1967 20 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekhan. Zhidkosti i Gaza (Moscow), no. 2, 1966 p 175–180

(FTD-HT-23-1079-67; AD-669526)

The article demonstrates experimentally that in nozzle optimization it is more expedient to use nozzles with weak shocks and some overexpansion, obtained by increasing the nozzle contour curvature as compared to that of a truncated perfect nozzle. Tests were conducted with a series of two-dimensional nozzles with a constant contour profile but with various degrees of flow expansion. Measurements were made of the static pressure distribution along the wall of the nozzle supersonic section and of the total pressure at the nozzle exit. The experimentally determined thrust of the nozzle supersonic section with an increased contour curvature was compared with the calculated thrust of the supersonic section of truncated perfect nozzles with uniform characteristics. The obtained results indicate that there is a definite range of nozzle dimensions at which the nozzles with increased contour curvatures are more advantageous than the truncated perfect nozzles. In this case, the contour inclination angle in a nozzle with a shock at the exit cross-section is not equal to zero and the shock effect is small. Author (TAB)

N68-29683# ARO, Inc., Arnold Air Force Station, Tenn.

STUDY OF THE BLUNT-BODY STAGNATION POINT VELOCITY GRADIENT IN HYPERSONIC FLOW

L. L. Trimmer Arnold Eng. Develop. Center May 1968 37 p refs

(Contract AF 40(600)-1200)

(AEDC-TR-68-99; AD-669378)

Results of an experimental investigation to determine the stagnation point velocity gradients for a family of blunt axisymmetric shapes at hypersonic Mach numbers are presented. Data presented in the form of model pressure distributions and stagnation point Mach number gradients are compared with existing data and theories. Although not accurately predicting the results, Newtonian theory is shown to provide a good basis for data correlation. Variations in model pressure distribution and stagnation point Mach number gradient from free-stream Mach number 6 to 10 were small and essentially within experimental precision. Model bluntness ranged from a hemisphere-cylinder to a flat-nose-cylinder, and data were obtained at free-stream Mach numbers 6, 8, and 10 and a nominal Reynolds number of 1,000,000, based on model diameter. Author (TAB)

N68-29692# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.

SUBSONIC OSCILLATORY OR STEADY AIRLOADS ON WINGS WITH CONTROL SURFACES AND OTHER DISCONTINUITIES

Holt Ashley Dec. 1967 56 p refs

(Contract F44620-67-C-0044)

(SUDAAR-336; AFOSR-68-0419; AD-669373)

Detailed procedures are described for numerical calculation of the lifting pressure distribution on a wing or tail with control surfaces or other discontinuities, oscillating in a subsonic main stream. The basis of the solution is the integral equation of a pressure doublet sheet, linearized under the hypothesis of small disturbances. The key discovery permitting a new approach to this problem is Landahls theorem, which shows that the magnitude of the pressure singularity along a discontinuity line such as a control leading or side edge is directly related to the upwash discontinuity at that edge. Two known exact solutions are shown to verify Landahls result. The report focuses on symmetrical motion of a pair of symmetrically-disposed trailing-edge controls with rectilinear, swept leading edges. The extensions to other cases, such as antisymmetrical motion, leading-edge flaps, controls with aerodynamic balance, etc., are discussed. Brief illustrations are presented on the use of matched asymptotic expansions in other discontinuity situations which may arise in lifting surface theory. Author (TAB)

N68-29749# Stanford Univ., Calif. Engineering Mechanics Div.

VISCOUS, HYPERSONIC FLOW AROUND A BLUNT BODY

John E. Kaiser and I. Fluegge-Lotz Jan. 1968 176 p refs

(Contract AF 49(638)-1385)

(TR-178; AFOSR-68-0988; AD-669578)

A simplified form of the Navier-Stokes equations was used to describe the flow in the shock layer of a blunt body. The equations are solved near the axis of the body by using the method of series truncation. The main method of solution is a finite difference method, which in principle allows one to handle axisymmetric bodies of arbitrary shape. The body shape is assumed to be given and the bow shock shape is determined step by step. Author (TAB)

N68-29795 Rice Univ., Houston, Tex.
HYPERSONIC MINIMUM DRAG BODIES OF GIVEN LIFT UNDER VARIOUS GEOMETRIC CONSTRAINTS
Arthur Herbert Lusty, Jr. (Ph.D. Thesis) 1967 53 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-13101

The problem of minimizing the drag of a slender, flat-topped body of semicircular cross section in a moderately hypersonic flow is considered under the assumption that the pressure coefficient is modified Newtonian and the surface-averaged skin-friction coefficient is constant. The indirect methods of the calculus of variations are employed, and the necessary conditions to be satisfied by an optimum body are derived for arbitrary conditions imposed on the lift, the wetted area, the volume, the length, the thickness and the thickness ratio. The particular cases treated are the following: (a) given lift, (b) given lift and thickness, (c) given lift and wetted area, (d) given lift and length, (e) given lift and thickness ratio, and (f) given lift and volume. Dissert. Abstr.

N68-29809# ARO, Inc., Arnold Air Force Station, Tenn.
AN EMPIRICAL CORRELATION OF PRESSURE ON BLUNT-NOSED CYLINDRICAL AFTERBODIES AT HYPERSONIC MACH NUMBERS
R. H. Eaves, Jr. Arnold AF Sta., Tenn. Arnold Eng. Develop. Center May 1968 71 p refs
(Contract AF 40(600)-1200)
(AEDC-TR-68-82; AD-669565)

The study provided a readily solvable correlating equation that accurately predicts the pressure distribution over the afterbodies of various blunt-nosed cylinders at hypersonic Mach numbers. The correlating equation is developed from experimental pressure data on a cylinder with three nose shapes (hemisphere, flat-face, and rounded-shoulder flat-face) at free-stream Mach numbers of 6, 8, and 10. For blunt-nosed cylinders with nose drag coefficients from 0.89 to 1.72, the correlating equation is applicable over an extended experimental range of Mach number from 5.0 to 10.2 for local pressures greater than free-stream pressure. A good correlation is obtained with the method of characteristics solutions for Mach numbers from 5 to 100 for ten nose diameters along the body, but the applicability of the correlating equation beyond the experimental limits was not demonstrated. Author (TAB)

N68-29837# Aeronautical Research Council (Gt. Brit.).
A MARCHING PROCEDURE FOR THE DETERMINATION OF INVISCID TWO-DIMENSIONAL SONIC FLOW PAST A BLUNT SYMMETRICAL BODY
D. G. Randall Nov. 1966 32 p refs Supersedes RAE-TR-66371 and ARC-29233
(ARC-CP-992; RAE-TR-66371; ARC-29233; AD-833490)

The equations of motion for two-dimensional, inviscid, sonic flow are written in a form that permits the introduction of a marching procedure for determining the flow past a symmetrical, blunt body. The independent variables are transformed to new variables, theta and S, such that points infinitely far from the body are mapped into the line theta = zero, the line of symmetry is mapped into the line S = zero, and the body contour is mapped into the line theta = one; marching takes place in the S direction, starting from the line S = zero. The dependent variables are also transformed, in such a way that the physical quantities have the correct asymptotic behavior far from the body. Author (TAB)

N68-29855# Aeronautical Research Council (Gt. Brit.).
THE CALCULATION OF SUB-CRITICAL PRESSURE DISTRIBUTIONS ON SYMMETRIC AEROFOILS AT ZERO INCIDENCE
P. G. Wilby Mar. 1967 40 p refs Supersedes NPL-AERO-1208 and ARC-28888
(ARC-CP-993; NPL-AERO-1288; ARC-28888; AD-833491)

Several compressibility correction rules that relate the sub-critical velocity on an aerofoil to the incompressible velocity are reviewed. Theoretical and experimental values for velocity at the crest of symmetric aerofoils at zero incidence are studied and a new compressibility correction factor is derived using third-order small disturbance theory. When used in conjunction with the incompressible Weber formula, this new compressibility factor is found to give good agreement with experiment. Author (TAB)

N68-29866# General Electric Co., Philadelphia, Pa. Missile and Space Div.
THE NON-EQUILIBRIUM AIR BOUNDARY LAYER ON A BLUNT NOSED BODY
Burt Kaplan Apr. 1968 42 p refs
(AD-833789)

This report presents the results of two non-equilibrium blunt body boundary layer calculations for a sphere cone configuration. The flight conditions and geometry are 21760 fps, 150 kft., sphere cone configuration, 8.6 deg. cone angle two nose radii were considered 0.5 and 1.5 inches. Resulting ion distributions are shown and discussed comparatively with inviscid reacting flow field calculations and with equilibrium boundary layer calculations. It is concluded that for the conditions considered neither the equilibrium boundary layer nor the inviscid calculations can be used to predict levels of electrons over the cone frustum. Author (TAB)

N68-29881# Aeronautical Research Council (Gt. Brit.).
EXPLORATORY INVESTIGATION OF THE EFFECTS OF BLOWING FROM THE LEADING EDGE OF A DELTA WING
W. J. G. Trebble London HMSO 1968 21 p refs Supersedes RAE-TR-66125; ARC-28391; see X67-11427
(ARC-R&M-3518; RAE-TR-66125; ARC-28391) CFSTI: HC $3.00/MF $0.65

Low-speed wind-tunnel tests were made to investigate the possibility of increasing the lift of a highly swept wing by ejecting high energy air from the leading edge. The results showed that lift gains were available, but that care should be taken to direct the emergent jet with the minimum possible forward component so that large drag penalties may be avoided. Author (ESRO)

N68-29884
ANALYSIS OF THE WAVE DRAG OF A BLUNT BODY OF REVOLUTION WITH A CONICAL TAIL SECTION IN SYMMETRIC HYPERSONIC FLOW
E. R. Abramovskii and V. A. Kovaleva [1968] 8 p refs Transl. into ENGLISH from Gidroaeromekhan. (Kharkov), no. 5, 1967 p 24–31
CFSTI: HC $3.00/MF $0.65

Expressions for computing the body surface behind the break in the generatrix and the wave drag coefficient of the conical tail section of a blunt body of revolution in symmetric hypersonic flow were determined. The computational method is based on approximating the pressure along the straight line portion of the generatrix; and separate mathematical models are derived for pressure on the nose cone and cylinder and for pressure on the tail cone. M.W.R.

N68-29891#
ON THE INFLUENCE OF MACH NUMBER ON BASE PRESSURE FLUCTUATIONS BEHIND A CONE
A. I. Shvets, Iu. A. Panov, A. M. Khazen, and V. A. Novikova [1968] 8 p refs Transl. into ENGLISH from Vestn. Mosk. Univ., Ser. 1: Mat. i Mekhan. (Moscow), no. 1, 1968 p 75–80
CFSTI: HC $3.00/MF $0.65

Gas discharge transducers were used to measure base pressure fluctuations behind pointed cones at Mach numbers 2 to 3.8. Dependence of the corona discharge parameters on the magnitude of the pressure in the cylindrical chamber containing the transducers

was investigated. Base pressure fluctuations may be caused by perturbation in the fundamental flow parameters and by model vibrations originating during operation; and measurements of the signal from the pressure transducer located on the lateral surface of the cone indicate that the energy level of these fluctuations is below the energy level of the base pressure fluctuations. Frequency of model vibrations do not agree with the frequency of the base pressure fluctuations either. A gas-discharge pressure transducer fastened at the bottom of the holder in the region of the wake throat recorded a considerably greater signal than the pressure transducer fastened on the base section. The spectrum of base pressure fluctuations is considered the complex superposition of a number of harmonic oscillations, including high frequency pulsations due to fluctuations in external flow parameters, fluctuations in compression shocks, and turbulent pulsations in the jet boundary of the stagnation zone. M.W.R.

N68-29896# Ministry of Technology, London (England). Technical Information and Library Services.

A NEW METHOD FOR CALCULATING THE TWO-DIMENSIONAL SUBSONIC FLOW ON THIN WING PROFILES WITH SMALL ANGLES OF INCIDENCE [NEUERE METHODE ZUR BERECHUNG DER EBENEN UNTERSCHALLSTROMUNG AN DUNNEN PROFILEN BEI KLEINEN ANSTELLWINKELN]

W. Gretler 1968 32 p refs Transl. into ENGLISH from Acta Mechanica (Austria), v. 1, no. 2, 1965 p 109–134
(TIL/T-5753; AD-833427)

A method is described with which it is possible to calculate the pressure distribution on the surface of a thin, cambered aerofoil in a simple way, at moderate incidence, in compressible, subsonic flow, up to the second order. The paper gives a complete derivation of the theory, including an investigation of the flow near a rounded leading edge. The starting point for the theoretical treatment is Green's formula—similar to that in the integral equation method for calculating transonic flow proposed by Oswatitsch and Zierep. By means of integral transforms and the application of the Tricomi's convolution theorem, the problem is reduced to the calculation of simple integrals. The derived formulas are particularly suitable for practical applications, since knowledge of only the profile ordinates is required. The velocity on the aerofoil surface, as given on a straightforward second approximation, is made uniformly valid near the leading edge by adding a few, simple corrections. Author (TAB)

N68-29912# Aeronautical Research Council (Gt. Grit.).

REAL-AIR EFFECTS IN PROPELLING NOZZLES

J. C. Ascough London HMSO Sep. 1966 42 p refs Supersedes NGTE-R-285; ARC-28513; see X67-12151
(ARC-R&M-3522; NGTE-R-285; ARC-28513) CFSTI: HC $3.00/MF $0.65

Properties of 'Real Air' in isentropic nozzle flow are compared with those of either 'Classic Air' for which $\gamma = 1.4$ exactly or 'Ideal Air' for which γ may vary, but which obeys the Ideal Gas law $P\rho = RT$. Having shown that there is little difference between Classic Air and Ideal Air in the total temperature range from 270 to 400 deg K, the present results are presented as ratios of Real Air/Classic Air mass flow intensity, and again as ratios of Real Air/Classic Air isentropic velocity. Operating conditions cover pressure ratios from 2 to 100, levels of inlet total pressure of 1, 4, 7 and 10 atms, and levels of inlet total temperature of 270, 290, 300, 350, and 400 deg K. Author (ESRO)

N68-29920*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

MODEL SAMPLING APPLIED TO THE NORMAL SHOCK PROBLEM

Morris Perlmutter 1968 5 p refs Presented at 6th Intern. Symp. on Rarefied Gas Dyn., Cambridge, Mass., 22–26 Jul. 1968
(NASA-TM-X-52471; E-4381) CFSTI: HC $3.00/MF $0.65 CSCL 01A

Model sampling or monte carlo is applied to the normal shock problem. Temperature and density profiles through the shock for Mach number of 10. It was assumed that the intermolecular collisions were Maxwellian and that the target molecules had a two sided half Maxwellian distribution. The results show a significant difference from previous analytical solutions. Important samplings is used to reduce the solution variance. Author

N68-29925# National Physical Lab., Teddington (England). Aerodynamics Div.

WIND TUNNEL TESTS ON A 1/45TH SCALE MODEL OF A MARCONI 90FT DIAMETER FULLY STEERABLE SATELLITE TRACKER

C. F. Cowdrey and M. Churchlow (Marconi Co., Ltd., Basildon, Engl.) Feb. 1967 30 p ref Prepared jointly with Marconi Co., Ltd., Basildon, Engl.
(NPL-AERO-1222) CFSTI: HC $3.00/MF $0.65

The results are recorded of measurements of forces and moments on a model of the Marconi 90ft diameter Satellite Tracker in the N.P.L. 7ft × 7ft Industrial Wind Tunnel. Author

N68-29945 Ohio State Univ., Columbus.

VISCOUS EFFECTS ON BLUNT CONES AT HYPERSONIC SPEEDS

Gerald Michael Gregorek (Ph.D. Thesis) 1967 165 p
Available from Univ. Microfilms: HC $7.60/MF $3.00 Order No. 67-10896

The pressure and heat transfer distributions on blunt cones at hypersonic speeds and low Reynolds number have been examined both experimentally and analytically. Following an extensive instrumentation development program, measurements of pressure on the cones were obtained which showed a strong influence of Reynolds number upon the 10° cone distribution, with measured pressures almost 25% above the inviscid solution at the lowest test Reynolds number. The 25° cone showed a smaller dependance upon the stream density level. Heat transfer rate measurements, nondimensionalized by the stagnation point rate, showed little variation with Reynolds number down to a Reynolds number of 5,000. An analytic prediction technique for pressure and heat transfer was formulated based upon inviscid solutions for pressure distribution and a local similarity boundary layer theory. An estimate was made of the effects of transverse curvature and stream vorticity upon the boundary layer solutions. Dissert. Abstr.

N68-29952*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

HYPERSONIC AERODYNAMIC CHARACTERISTICS OF LOW-WAVE-DRAG ELLIPTICAL-BODY-TAIL COMBINATIONS AS AFFECTED BY CHANGES IN STABILIZER CONFIGURATION

Charles H. Fox, Jr. and Bernard Spencer, Jr. Washington Aug. 1968 44 p refs
(NASA-TM-X-1620) CFSTI: HC $3.00/MF $0.65 CSCL 01A

This investigation represents the initial portion of a study to determine methods of providing stability from hypersonic through low subsonic speeds for vehicles with high hypersonic lift drag ratios. The results of this investigation indicate that the maximum untrimmed lift drag ratio is reduced approximately 15 percent due to the outboard stabilizers for either 'fineness' ratio body. The resultant aerodynamic performance is, however, relatively insensitive to changes in the outboard stabilizer dihedral angle for any given configuration tested. For a moment reference location selected as 55 percent of the body length, the outboard stabilizers set at

positive dihedral angles provide positive pitching moment at zero angle of attack, less out of trim pitching moment at maximum lift drag ratio, and resultantly less increase in stability variation with increasing angle of attack as compared with outboard stabilizers set at negative dihedral angles. In addition, the directional-stability parameter at maximum lift drag ratio varies nonlinearly with outboard stabilizer dihedral angle with a maximum stabilizing effect indicated in the dihedral angle region from 30° to 60° for positive dihedrals. Author

N68-29955*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

EFFECT OF HINGE-LINE BLEED ON HEAT TRANSFER AND PRESSURE DISTRIBUTION OVER A WEDGE-FLAP COMBINATION AT MACH 10.4

H. Harris Hamilton and J. David Dearing Washington Aug. 1968 46 p refs

(NASA-TN-D-4686) CFSTI: HC $3.00/MF $0.65 CSCL 01A

An experimental investigation has been conducted to determine the effect of boundary layer bleed on the heat transfer and pressure distributions over a wedge-flap combination with a gap between the wedge and flap. The model was tested, with the wedge at angles of attack of 6.83° and 12.83° and the flap deflected up to 30°, at a nominal free-stream Mach number of 10.4 and free stream Reynolds numbers (based on distance to the flap hinge line) of 0.8×10^6 and 3.6×10^6. At the lower free-stream Reynolds number, the boundary layer was laminar over the entire model. The pressure and heat transfer over the forward portion of the flap increased slightly as the gap size increased. At the higher free stream Reynolds number, the boundary layer was transitional at the hinge line for an angle of attack of 6.83° and was fully turbulent for an angle of attack of 12.83°. Under these conditions, the largest flap deflection of the tests did not separate the boundary layer even with the gap sealed, and increasing the gap size had very little effect on either the pressure or heat-transfer distributions. The turbulent heat transfer rate for deflected flap was predicted reasonably well by the Spalding and Chi turbulent theory by using boundary layer edge properties calculated from oblique shock theory and by assuming that the turbulent boundary layer originated at the flap hinge line. Author

N68-29979

AERODYNAMIC CHARACTERISTIC OF CONICAL NON-AXISYMMETRIC BODIES

A. I. Shvets [1968] 7 p refs Transl. into ENGLISH from Izv. AN SSSR, Mekh. Zhidkosti i Gaza (Moscow), no. 2, 1968 p 112–116

CFSTI: HC $3.00/MF $0.65

Elliptic cones with various vertex angles and semi-axes ratios were tested in the 0.6 to 4.0 Mach number range to investigate aerodynamic characteristics. Surface pressure distribution and acting forces were measured; weight tests were performed, wave drag coefficients were derived, and theoretical experimental values of total drag were compared. Lift of elliptic cones is investigated, and experimental results are compared with results obtained from slender body theory and linearized wing theory. It is concluded that aerodynamic quality of elliptic cones increases with decreasing semi-axes ratio and vertex angle. Maximum quality is achieved in 10° to 20° attack angle range, and increases as thickness decreases. D.H.B.

N68-29991 Illinois Univ., Urbana.

DRAG FORCES OF TWO-DIMENSIONAL V-SHAPED NOTCHES IN TRANSONIC AND SUPERSONIC TURBULENT FLOW

Ronald Hunter Howell (Ph.D. Thesis) 1967 174 p

Available from Univ. Microfilms: HC $8.00/MF $3.00 Order No. 67-11869

The major objectives of this investigation were to seek an understanding of the flow mechanisms and the controlling parameters for flow in v-shaped notches and the development of experimental methods for measuring the drag of v-shaped notches. The wall geometry was limited to two-dimensional symmetric notches defined by specifying the length and angle of the notch. For any given notch geometry the free stream Mach number was the primary variable while the viscous effects, specified by the boundary layer momentum thickness and the length Reynolds number, were secondary variables. Schlieren observations, pressure distributions, and direct drag force measurements(with a specially developed drag force balance) contributed to a better understanding of the viscid-inviscid flow phenomena controlling the drag of notches and the redevelopment of the boundary layer downstream of the disturbance. Dissert. Abstr.

N68-29994*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

EFFECT OF VARIABLE STATOR AREA ON PERFORMANCE OF A SINGLE-STAGE TURBINE SUITABLE FOR AIR COOLING. 1: STATOR OVERALL PERFORMANCE WITH 130-PERCENT DESIGN AREA

Edward M. Szanca, Frank P. Behning, and Harold J. Schum Washington Aug. 1968 22 p refs

(NASA-TM-X-1632) CFSTI: HC $3.00/MF $0.65 CSCL 01A

The turbine is being investigated at stator area settings of 70, 100, and 130 percent of design. This report presents the overall stator performance at the open setting and compares the results with those obtained from design tests. Results are presented in terms of weight flow, outlet flow angle, blade surface static pressure and velocity distributions, as well as inner and outer wall static pressures as obtained over a stator pressure ratio range. Author

N68-30030*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

AERODYNAMIC CHARACTERISTICS OF TWO BLUNT, HALF-CONE WEDGE ENTRY CONFIGURATIONS AT MACH NUMBERS FROM 2.30 TO 4.63

Gerald V. Foster Washington Aug. 1968 35 p

(NASA-TM-X-1621) CFSTI: HC $3.00/MF $0.65 CSCL 01A

An investigation has been conducted in the Langley Unitary Plan wind tunnel to determine the aerodynamic characteristics in combined pitch and sideslip for two blunt, half-cone–wedge entry vehicles at Mach numbers from 2.30 to 4.63. The vehicles differed primarily in length. The results of the investigation indicated that both configurations were longitudinally stable although the drag level was greater for the short configuration. Both configurations exhibited positive directional stability and a positive dihedral effect throughout the ranges of angle of attack and Mach number; however, the parameters for the long configuration varied considerable with angle of attack. Author

N68-30033*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

OVERALL PERFORMANCE IN ARGON OF A 6-INCH RADIAL-BLADED CENTRIFUGAL COMPRESSOR

Edward R. Tysl, Calvin L. Ball, Carl Weigel, and Laurence J. Heidelberg Washington Aug. 1968 28 p refs

(NASA-TM-X-1622) CFSTI: HC $3.00/MF $0.65 CSCL 01A

Overall and impeller performance is presented as a function of equivalent weight flow. At the design equivalent weight flow of 1.52 pounds per second (0.69 kg/sec) and design equivalent tip speed of 989 feet per second (301.5 m/sec) the compressor developed an overall total pressure ratio of 2.3 with an adiabatic efficiency of 76.5 percent. Peak efficiency at design speed was 78.0 percent and occurred at an equivalent weight flow of 1.35 pounds per second (0.61 kg/sec). Author

N68-30043*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A NUMERICAL SOLUTION OF UNSTEADY FLOW IN A TWO-DIMENSIONAL SQUARE CAVITY
Leo F. Donovan Washington 1968 25 p refs To be presented at the 61st Ann. Meeting of the Am. Inst. of Chem. Engr., Los Angeles, 1–5 Dec. 1968
(NASA-TM-X-52459) CFSTI: HC $3.00/MF $0.65 CSCL 20D

The continuity equation and unsteady Navier–Stokes equations are solved numerically for two dimensional flow in a square cavity. The fluid is initially at rest and the upper surface of the cavity moves with constant velocity throughout the calculation such that the Reynolds number of 100, based on the length and velocity of the moving surface and the viscosity of the fluid. Good agreement is shown between the calculated position of the vortex center at large times and both the position of an experimentally determined vortex center and the position of the vortex center calculated from an extant solution of the steady Navier–Stokes equations. Velocity profiles at large times are in excellent agreement with those calculated from an extant solution of the steady Navier–Stokes equations. Another method of presenting the results of the calculations is also used to illustrate the results more clearly. An initial distribution of marked particles is created at the start of the calculation. Thereafter, at each time step, after Navier–Stokes equations are solved, the marked particles are moved to their new locations, displayed on a cathode ray tube, and photographed. Author

N68-30081# Lincoln Lab., Mass. Inst. of Tech., Lexington.
PRESSURE DISTRIBUTIONS ON SPHERE-CONE RADOMES IN UNIFORM AND GRADIENT FLOWS
Richard D'Amato and William R. Fanning 2 May 1968 45 p ref
(Contract AF 19(628)-5167)
(ESD-TR-68-84; TN-1968-17; AD-670168)

A series of wind tunnel tests on two radome models, composed of truncated spheres on conical bases, in both uniform and two power law gradient flow conditions are described in the report. The data from these tests are presented in the form of actual pressure coefficients and as Fourier coefficients which have been best-fitted to the experimental data. Comparisons are presented to show the manner in which these pressure distributions vary from each other for the differing model and flow conditions. Author (TAB)

N68-30112# Aerospace Research Labs., Wright-Patterson AFB, Ohio.
PRESSURE DISTRIBUTION ON A CONE-CYLINDER-FLARE BODY AT MACH 14 IN THE PRESENCE OF FLOW SEPARATION
Eric G. Friberg Feb. 1968 61 p refs
(ARL-68-0032; AD-669328)

Surface pressure data are presented for a cone-cylinder-flare body with 20 deg and 40 deg flare angles at a nominal freestream Mach number of fourteen. Separation of the flow due to the adverse pressure gradient induced by the flare was found in both cases. Appreciable extent of separation existed in the 40 deg flare case, while for the 20 deg flare separation was less severe. A correlation formula using the viscous interaction parameter is shown to be valid for a wide range of Mach numbers and model geometries. Author (TAB)

N68-30128*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DILUTION-JET MIXING STUDY FOR GAS-TURBINE COMBUSTORS
Carl T. Norgren and Francis M. Humenik Aug. 1968 45 p refs
(NASA-TN-D-4695; E-4213) CFSTI: HC $3.00/MF $0.65 CSCL 01A

An experimental mixing study was undertaken to evaluate various dilution-jet entries. Thirteen geometries including four geometric variations on rectangular diluent jets with flush openings, attached scoops immersed in the diluent air stream, attached chutes immersed in the hot air stream, and a single geometry incorporating flush circular holes were investigated. Diluent and hot streams with a velocity ratio from 0.55 to 2.20 (diluent stream Mach range 0.082 to 0.232) were introduced into the rectangular configuration exhausting directly to the atmosphere. The mixed-stream exhaust temperature was in the order of 750° to 975°R. Test conditions were representative to scaled engine operation by geometric, velocity, and Reynolds number similarity. Author

N68-30175# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
NOZZLE APPARATUS OF AXIAL TURBINE [SOPLOVOI APPARAT OSEVOI TURBINY]
D. A. Dekhovich, V. P. Merlis, and V. G. Perfilov 22 Jun. 1967 9 p Transl. into ENGLISH from Russian patent no. 167406 (appl. no. 852448/24-6, 14 Aug. 1963) 2 p
(FTD-HT-66-668; AD-670122)

The report presents an axial turbine nozzle assembly containing movable blades with spherical ends, mounted on axes passing through a shielding rim and nozzle assembly body. The blades interact with a rotating disk through levers with spherical heads. To eliminate the effects of thermal deformations of the flow-exposed parts on the blade turning mechanism and on the centering of the shielding rim with respect to the body, the blade axes are set in bushings mounted in the shielding rim and the body. To decrease leakage through the end clearances and to fix the blades in the radial direction, an alternate design provides shoulders on the axes where they enter the blade. To provide reliable turning of the guide disk, a third design has the disk supported against ball bearings connected through eccentric axes to an intermediate ring mounted on the body with radial pegs. Author (TAB)

N68-30204*# Scripta Technica, Inc., Washington, D. C.
MEASUREMENT OF THE DRAG OF A STAR-SHAPED BODY IN HYPERSONIC FLOW AT M=6 AND 8 [IZMERENIYE SOPROTIVLENIYA TELA ZVEZDOOBRAZNOY FORMY V SVERKHZVUKOVOM POTOKE PRI CHISLAKH M=6 I 8]
A. L. Gonor, M. N. Kazakov, and A. I. Shvets NASA Jul. 1968 5 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekhan. Zhidkosti i Gaza (Moscow), 1968 p 94–97
(Contract NASw-1694)
(NASA-TT-F-11834) CFSTI: HC $3.00/MF $0.65 CSCL 01A

Experimental measurement of the aerodynamic drag of a conical body with a star-shaped cross section at Mach 6 and 8 together with a photographic analysis of the wake pattern behind the body. Experimental and theoretical data are compared for the drag of a cone and a star-shaped body. The results indicate that the overall drag of the star-shaped body is less than half as great as the drag of an equivalent circular cone. The jump pattern arising in the flow around the star-shaped body is analyzed and the flow between the points of the star is illustrated. Author

N68-30229
ANALYSIS OF THE SHAPE OF THE SHOCK AHEAD OF A CONICAL TAIL SECTION OF A BLUNT BODY OF REVOLUTION
E. R. Abramovskii and F. I. Avrakhov [1968] 5 p refs Transl. into ENGLISH from Gidroaeromekhan. (Kharkov), no. 5, 1967 p 32–37
CFSTI: HC $3.00/MF $0.65

In view of the fact that the gas dynamic parameters ahead of the conical tail section and the shape of the inner shock are initial data for various approximate methods of computing the pressure on the surface of a body of revolution, and in view of the

difficulty involved in computing the shape of the shock since a perturbed stream flows over the conical tail section, approximate relationships were developed which have applicability in inner shock computations. Analyzed is a body of revolution consisting of a nose cone, a cylinder, and a conical tail section. The nose cone can have bluntness within the limits $0 \leq r_T \leq 1$. It is considered that the pressure and Mach number on the body surface ahead of the break are known. To determine the shape of the shock, assumptions based on an analysis of the physical picture of the flow are used. To further illustrate the applicability of the proposed approach, the shape of a shock ahead of the tail section of bodies of revolution which have nose and tail cones with a specified half angle is analyzed. Comparative results of computations using the proposed method, and using the method of characteristics are given.
S.C.W.

N68-30236*# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
AN EXPERIMENTAL AND ANALYTICAL INVESTIGATION OF SHOCK-WAVE REFLECTION IN A CHEMICALLY RELAXING GAS
Ronald K. Hanson May 1968 151 p refs
(Grant NGR-05-020-245)
(NASA-CR-95865; SUDAAR-345) CFSTI: HC $3.00/MF $0.65 CSCL 01A

The normal reflection of a shock wave from a shock-tube end wall is studied analytically and experimentally for a chemically relaxing diatomic gas. The pressure exerted on the end wall during the reflection process is obtained analytically by means of inner and outer asymptotic solutions. Knowledge of the pressure solution enables computation of the time evolution of all thermodynamic properties adjacent to the end wall; these calculations typically consume less than one minute of computing time. A fast-response pressure gauge with a risetime of .2 μsec and a useful recording time of up to 14 μsec is used to measure end-wall pressure histories in pure N_2 for incident shock speeds ranging from 4 to 7 km/sec. The chemical reaction rates of the shock-heated N_2 are inferred by using the theoretical solution for pressure. These new rates are compared with existing data, and justifications for applying this technique in future chemical-kinetics studies are given. An interesting result of the unsteady reflection process is the formation of a non-uniform entropy layer adjacent to the end wall. Numerical results are presented to describe the character and extent of this entropy layer in chemically or vibrationally relaxing O_2-N_2 and CO_2.
Author

N68-30336*# Techtran Corp., Glen Burnie, Md.
INVESTIGATION OF A SUPERSONIC GAS FLOW AND HEAT TRANSFER IN THE REGION OF AN INCIDENT SHOCK WAVE ON A CYLINDER [ISSLEDOVANIYE TECHENIYA GAZA I TEPLOPEREDACHI V OBLASTI PADENIYA SKACHKA UPLOTNENIYA NA TSILINDR, OBTEKAYEMYY POTOKOM BOL'SHOY SVERKHZVUKOVOY SKOROSTI]
M. P. Teterin Washington NASA Jul. 1968 8 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekhan. Zhidkosti i Gaza (Moscow), no. 3, 1967 p 92–97
(Contract NASw-1695)
(NASA-TT-F-11795) CFSTI: $3.00 CSCL 01A

Supersonic gas flow and heat transfer in the region of an incident shock wave on a cylinder are investigated. The effect of an incident shock wave on a cylinder is reduced to the effect of a low-entropy stream formed as the result of incident-reflected shock wave interaction. Thus, the flow in the region of incidence may be considered to be a uniform low-entropy stream over a plate at certain incidence with the surrounding flow neglected. Precise measurements were made of the heat transfer on a thin walled (0.75 mm) cylinder 40 mm in diameter at $M_1 = 5$. The effect of an incident shock was observed by the erosion of material on a plexiglass cylinder visible on shadowgraph records. The effect of M on the incident shock wave effects with and without regard to the variable heat capacity ratio is investigated, and the results are given in graphs. The results confirm the existence of high intensity heat fluxes in the region where the low-entropy stream spreads over the cylinder surface.
Author

N68-30337*# Techtran Corp., Glen Burnie, Md.
DEPENDENCE BETWEEN THE STROUHAL AND REYNOLDS NUMBERS IN TWO-DIMENSIONAL FLOW PAST A CIRCULAR CYLINDER [O ZAVISIMOSTI MEZHDU CHISLAMI STRUKHALYA I REYNOL'DSA PRI PLOSKOM OBTEKANII KRUGOVOGO TSILINDRA]
S. G. Popov Washington NASA Jul. 1968 7 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekhan. Zhidkosti i Gaza (Moscow), no. 2, 1966 p 156–159
(Contract NASw-1695)
(NASA-TT-F-11763) CFSTI: HC $3.00/MF $0.65 CSCL 01A

The relationship between the Strouhal and Reynolds numbers in two-dimensional flow around circular cylinders and the structure of the vortical wake behind the cylinders are investigated for the cases of stationary and vibrating cylinders for a wide range of Reynolds numbers including the subcritical, critical, and supercritical zones. New data are compared and supplemented with old data and theories of the real function S(R) are derived for a circular cylinder. Separate data from studies on the nature of the oscillators of smoke stacks transverse to the wind are collected and processed.
Author

N68-30367*# Techtran Corp., Glen Burnie, Md.
AN EXPERIMENTAL INVESTIGATION OF THE EFFECT OF MACH AND REYNOLDS NUMBERS ON THE STRUCTURE OF A SUPERSONIC RARIFIED GAS FLOW IN THE STAGNATION REGION OF A BLUNT BODY [EKSPERIMENTAL'NOYE ISSLEDOVANIYE VLIYANIYA CHISEL MAKHA I REYNOL'DSA NA STRUKTURU SVERKHZVUKOVOGO POTOKA RAZREZHENNOGO GAZA V OKRESTNOSTI PEREDNEY KRITICHESKOY TOCHKI ZATUPLENNOGO TELA]
A. V. Ivanov Washington NASA Jul. 1968 12 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekhan. Zhidkosti i Gaza (Moscow), no. 3, 1967 p 108–115
(Contract NASw-1695)
(NASA-TT-F-11797) CFSTI: HC $3.00/MF $0.65 CSCL 01A

The effects of Mach and Reynolds numbers on the structure of a supersonic rarefied gas flow in the stagnation region of a blunt body are experimentally investigated. The electron beam method which utilizes the attenuation of an electron beam for the determination of density fields in the stagnation region of a disk and a sphere is used here in cases of various low-density flow regimes. Three series of measurements were conducted. The analysis of the results shows: (1) the increase in shock wave thickness with the decrease of density leads to the occurrence of relaxation effects in the compressed gas layer ahead of a body; (2) with a further decrease in density the shock wave vanishes and the flow becomes a free-molecular flow; (3) the ratio of the shock-detachment distance Δ to the length of a free path λ_∞ in a free flow may be considered as the flow criterion for flow regimes taking place prior to disappearance of the shock wave. However, the number of collisions experienced by a certain molecule in passing through a disturbed layer ahead of a body appears to be a more rigorous criterion.
Author

N68-30388*# Techtran Corp., Glen Burnie, Md.
SLENDER TWO-DIMENSIONAL BODIES OF MINIMUM WAVE DRAG IN A NONEQUILIBRIUM SUPERSONIC FLOW [TONKIYE PLOSKIYE TELA MINIMAL'NOGO VOLNOVOGO SOPROTIVLENIYA V NERAVNOVESNOM SVERKHZVUKOVOM]

A. N. Krayko and R. A. Tkalenko Washington NASA Jul. 1968 14 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekhan. Zhidkosti (Moscow), no. 4, 1967 p 56–63
(Contract NASw-1695)
(NASA-TT-F-11803) CFSTI: HC $3.00/MF $0.65 CSCL 01A

The determination of two-dimensional, slender profiles of minimum drag in the case of nonequilibrium supersonic flow is carried out in linear approximation. This approach yields a more complete representation of the optimum profile form. The problem considered here consists in constructing a minimum drag contour passing through points a and c at a given free flow and a fixed maximum length of $L^* - x_c^*$, which is taken as the characteristic linear dimension. Computations by the iterative method were carried out on an M-20 computer. The results, presented in graphs and a table, show that the decrease in drag obtained with optimal profiles is insignificant when compared with contours made of rectilinear segments. Author

N68-30492# Aeronautical Research Inst. of Sweden, Stockholm.
LIFTING-LINE THEORY FOR SUBSONIC SHEAR FLOW
Bo Johansson Oct. 1967 20 p refs
(FFA-114) CFSTI: HC $3.00/MF $0.65

The method of matched asymptotic expansions is applied to the linearized problem of a wing in steady subsonic shear flow, the Mach number and other free stream properties, varying in the spanwise direction only. The ratio of the chord of the wing to a scale length of the free stream inhomogeneity is assumed to be small and is chosen as the perturbation parameter. A perturbation potential is introduced, and its two term expansion is calculated. This yields a two term expansion of the spanwise lift distribution and a one term expansion of the induced drag distribution. As a numerical example, the case of a wing spanning a jet is considered. Author

N68-30511# Deutsche Forschungsanstalt fur Luft- und Raumfahrt, Brunswick (West Germany).
THE QUANTITATIVE APPLICABILITY OF THE HYDRAULIC ANALOGY FOR FLOWS AROUND BLUNT BODIES [DIE ANWENDBARKEIT DER GAS-FLACHWASSER-ANALOGIE IN QUANTITATIVER FORM AUF STROEMUNGEN UM STUMPFE KOERPER]
Guenther Niehus Jan. 1968 167 p refs In GERMAN; ENGLISH summary
(DLR-FB-68-21) CFSTI: HC $3.00/MF $0.65

Aerodynamic decelerators are blunt bodies of special technical interest. These devices have to operate within extensive variations of speed and density. In most cases, the investigations of aerodynamic decelerators are difficult in any way. The method of hydraulic analogy is well suited for getting first statements. In the first part of this study, the theoretical foundations and the experimental methods of the hydraulic analogy are explained so as to describe the advantages and the limits of the applicability. Essential recognitions of this paper will be gained by comparing the experimental and theoretical results of flows of air and shallow water around several blunt bodies. Author

N68-30595*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A WIND TUNNEL INVESTIGATION OF JET-WAKE EFFECT OF A HIGH-BYPASS ENGINE ON WING-NACELLE INTERFERENCE DRAG OF A SUBSONIC TRANSPORT
James C. Patterson, Jr. Washington Aug. 1968 43 p refs
(NASA-TN-D-4693) CFSTI: HC $3.00/MF $0.65 CSCL 01A

An experimental wind-tunnel investigation was conducted recently to determine the aerodynamic interference associated with underwing fan-jet engine–pylon installations including the effect of a jet wake from a powered high bypass fan-jet engine. Tests were made on a semispan model of a typical transport airplane configuration. These tests were conducted over a Mach number range of 0.70 to 0.84, at angles of attack from 0° to 4°, and over a Reynolds number range of 6.67×10^6 to 7.38×10^6 based on the mean geometric chord of 58.30 centimeters. The data indicate that the interference drag for the type of underwing engine–pylon installation investigated may be favorable as a result of a reduction in induced drag associated with an inboard end-plate effect of the nacelle–pylon. The addition of engine power has a strong influence on aerodynamic interference. The longitudinal and vertical position of the engine relative to the wing also has a pronounced effect on interference drag. The greatest favorable interference was obtained during this investigation with the engine in the most forward longitudinal and lowest vertical test position. An increase in Mach number above the design speed has an adverse influence on the aerodynamic interference. Author

N68-30633# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE EFFECTING OF A STEADY MIXING IN JETS [OB USTANOVLENII STATSIONARNOGO SMESHENIYA V STRUYAKH]
V. T. Kireyev 24 Aug. 1967 11 p refs Transl. into ENGLISH from Izv. Adad. Nauk SSSR, Mekhan. Zhidkosti i Gaza (USSR), no. 4, 1966 p 177–180
(FTD-HT-67-54; AD-670061)

The flow of plane and axisymmetric jets is analyzed. Using the method of integral relationships, an approximate calculation is presented of the time for establishing steady-state flow mixing at various cross sections of a jet. Author (TAB)

N68-30658
INVESTIGATION OF THE FLOW AROUND A SPHERE IN FREE FLIGHT
A. P. Bedin, I. M. Dement'ev, and G. I. Mishin [1968] 6 p refs Transl. into ENGLISH from Prikl. Mekh. i Tekhn. Fiz. (USSR), no. 2, 1968 p 95–98
CFSTI: HC $3.00/MF $0.65

Results of quantitative and experimental studies of the influence of Reynolds number on the geometric flow characteristics originating during boundary layer separation from the surface of a sphere in free flight are reported. Shadow photographs of the flow around a sphere were obtained on ballistic apparatus from which the separation flow was measured and the bow shock standoff was determined. Experiments were in air ($t \approx 17°C$) at atmospheric and reduced pressures, in the 0.8 to 4.0 range of Mach numbers. Duraluminum spheres and ball bearing steel spheres were fired on an artillery range at a pressure of $p \approx 190$ mm Hg. The Reynolds number varied proportionately to the flight velocity, the sphere's diameter, and the pressure at the range between 6×10^4 and 4.6×10^6 during tests. To investigate the influence of roughness on boundary layer separation, experiments were conducted with 20 mm steel spheres and rough duraluminum spheres of the same diameter in air at atmospheric pressure. Presented are results of measurements of: (1) the location of the boundary layer separation point; (2) the magnitude of the angle between the tangent to the surface of the sphere at the point it intersects a continuation of the shock wave, and the tangent to the surface of separation; and (3) the slopes of compression shocks originating in the neighborhood of the separation point to the visible boundary of separation. S.C.W.

N68-30670*# Techtran Corp., Glen Burnie, Md.
SELECTION OF A WING SHAPE FOR HYPERSONIC VELOCITIES [VYBOR FORMY KRYLA DLYA GIPERZVUKOVYKH SKOROSTEY]

G. I. Maykapar Washington NASA Jul. 1968 16 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekhan. Zhidkosti i Gaza (USSR), no. 4, 1967 p 40–49
(Contract NASw-1695)
(NASA-TT-F-11802) CFSTI: HC $3.00/MF $0.65 CSCL 01C

The selection of the shape and general dimensions of a wing moving at hypersonic speed is considered as an extremal problem with respect to minimum drag at a given lift, volume, leading edge temperature, and other parameters. The characteristic parameters on which the optimum profile of the longitudinal cross-section depend are determined with emphasis on their values, which separate those cases of known and unknown volume. It is shown that there exists a relative wing thickness for which the lift-drag ratio attains the maximum value at a given detrimental drag, and also that a spherical segment is not always the optimum shape for a leading edge in the stagnation point region. The Newton "law" for pressure and the "average" friction coefficient, which is independent of the wing shape, are used for solving the problem. Certain general characteristics of the wing which depend on the angle of attack are considered. Estimates of maximum possible values of lift-drag ratio obtained here are very close to those obtained by D. Kuchemann, thus permitting a verification of the results obtained according to Newton's law. Author

N68-30828*# Techtran Corp., Glen Burnie, Md.
THE NON-STATIONARY CALCULATION OF FLOW PAST A RECTANGULAR WING OF LOW ASPECT RATIO [RASCHET OBTEKANIYA PRYAMOUGOL'NOGO KRYLA MALOGO UDLINENIYA PO NESTATSIONARNOY TEORII]
B. B. Bukhovtsev and N. V. Stepanova Washington NASA Jun. 1968 12 p refs Transl. into ENGLISH from Vestn. Mosk. Univ., Ser. 1: Mat. i Mekhan. (Moscow), v. 23, no. 1, 1968 p 82–90
(Contract NASw-1695)
(NASA-TT-F-11823) CFSTI: HC $3.00/MF $0.65 CSCL 01A

Reported is a study of the action of an ideal fluid flow on an infinitely slender wing of rectangular planform performing oscillations in the flow. This study shows that the integral equation (derived by Bisplinghoff et al. on the basis of the Biot-Savart relation) describing the vorticity at the wing and in the wake can be solved by a vortex-lattice technique. The nonstationary forces thus obtained yield satisfactory results for the total lifting force, even for a relatively large lattice step. The effect of the wake appears to be substantial only for distances on the order of the chord and may be disregarded when the wavelength exceeds the chord by a factor of 10 or greater. The lift distribution over an oscillating wing of finite aspect ratio is also calculated. Author

N68-30831*# National Aeronautics and Space Administration, Washington, D. C.
DYNAMIC PERFORMANCE OF BLADE ROWS
Hiroyuki Takata Jul. 1968 5 p Transl. into ENGLISH from Tokyo Daigaku Kogakubu Kiyo A (Japan), no. 5, 1967 p 27–29
(NASA-TT-F-11838) CFSTI: HC $3.00/MF $0.65 CSCL 01A

To estimate the dynamic performance of blade rows in unsteady flow conditions, experiments were carried out using a counter-rotating axial flow compressor. The stall pattern of rotating stall was brought to rest under some operating conditions, and distributions of velocities and pressures just upstream and downstream of the blade rows were measured. Analysing these flow through the blade rows, the time delay of the blade boundary layer response was estimated. The result shows that the ratio of the time constant of boundary layer delay to the time constant of inertia delay of the flow in the blade channel is about 1 to 2. Author

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N68-29599# Royal Aircraft Establishment, Farnborough (England).
CAN SIGHTING REPORTS INDICATE COLLISION RISK OVER THE NORTH ATLANTIC?
D. E. Lloyd May 1967 24 p refs
(RAE-TR-67122) CFSTI: HC $3.00/MF $0.65

It was suggested that by collecting sighting reports from North Atlantic air traffic and cross-checking them against air traffic control records it would be possible to identify some reports as due to aircraft straying from their cleared track, and that changes in the rate of such "validated" reports could be used to detect changes in lateral collision risk, i.e. in the risk which is due to loss of lateral separation. Examination indicated that the number of validated sightings is not large enough to enable an important change in collision risk to be detected within a reasonable period of time. Author

N68-29646 British Aircraft Corp., Weybridge (England).
OBSERVATIONS ON DESIGNING TO COMBAT FATIGUE AND ITS EFFECTS ON THE ECONOMICS OF CIVIL TRANSPORT AIRCRAFT
D. M. McElhinney Mar. 1967 42 p

Effects of increasingly complex design in British civil transport aircraft on manufacturing and operational expenditures are reviewed. Costs in manufacture, development, tests, and operations attributable to fatigue are contrasted with safety, reliability, trouble-free characteristics, service life, and residual value. Significant types of fatigue in the design stage are shown in aircraft designed for operation between 1945 and 1972 by enumerating aircraft elements subject to various fatigue cases. Other factors at the design stage are design criteria which require fatigue determination, choice of materials, electronic computer applications to design, and thermal stress. Fatigue consideration in the manufacturing stage is exemplified in machined construction and labor/materials costs. Designs specifying long fatigue life, fail-safe criteria, and acoustic fatigue requirements have contributed to the complexity of the development testing stage. In the operational stage, fatigue minimization design generally raises direct operating costs by increased structural weight and decreased payload. The review concludes that freer, wider, and more rapid operational experience interchange between manufacturers, flight safety authorities, and operators would achieve greater safety, more economy of operation, and better aircraft design. D.H.B.

N68-29728 Aeronautical Research Labs., Melbourne (Australia).
AGRICULTURAL AIRCRAFT FLIGHT LOADS: TYPICAL SPECTRA AND SOME OBSERVATIONS ON AIRWORTHINESS
P. J. Foden [1967] 26 p refs Presented at the 5th I.C.A.F. Symp. on Aircraft Fatigue-Design, Operational and Economic Aspects, Melbourne, 22–24 May 1967

A mean agricultural flight load spectrum is presented, based on the results of measurements taken with 13 pilots. Reasons are given for using the pilot, rather than time, as the parameter. A gust spectrum for altitudes of less than 100 feet is derived. It is shown that, when choosing the severity of a manoeuvre, pilots make a quite accurate allowance for the load in their aircraft. The strains

measured in the wing structure of the aircraft in these experiments are used to define an upper limit to the expected life of the aircraft. It is suggested that normal factors of safety on life need to be doubled to cover the wide differences in piloting techniques which have been noted in this type of flying. Author

N68-29873# Boeing Co., Renton, Wash. Commercial Airplane Div.
POSSIBILITIES AND DEVICES FOR THE SUPPRESSION OF JET NOISE
Edward Grande [1968] 48 p
(D6-20609; AD-669210)

The paper discusses the present state of the development of techniques for the suppression of jet noise. The theoretical models on jet noise are mentioned briefly, and the design principles for jet noise suppressors are discussed in detail. In defining the generation of jet noise, the following three separate velocity regimes are considered: (low speed jets), (moderate speed jets), and (high speed jets). The discussion on jet noise suppression considers each velocity regime separately, taking into account the extensive overlap between the regimes. Author (TAB)

N68-29880# Aeronautical Research Council (Gt. Brit.).
WHIRL OF AN AIRCRAFT POWER-PLANT INSTALLATION AND ITS INTERACTION WITH THE FLUTTER MOTION OF A FLEXIBLE WING
G. E. Smith London HMSO Aug. 1966 53 p refs Supersedes RAE-TR-66284; ARC-28926; see X67-17042
(ARC-R&M-3536; RAE-TR-66284; ARC-28926) CFSTI: HC $3.00/MF $0.65

Results of propeller whirl analyses in four degrees of freedom are presented for a typical turbo-prop aircraft power-plant installation consisting of a rigid engine supported with elastically restrained freedoms in pitch and yaw at the end of a flexible nacelle cantilevered from a rigid support structure. Calculations were made for a range of structural and aerodynamic parameters. Only one of the four modes was found to become unstable within the airspeed range covered, the critical whirl airspeed being very sensitive to engine-mount damping and to the nacelle and engine-mount stiffnesses. The interaction between power-plant whirl and wing flutter was investigated by extending the calculations to include twelve degrees of freedom, four normal modes of vibration of the half wing plus four modes for each of two power-plant installations on the half wing. The results suggest that the stability of the power-plant whirl modes is not adversely affected by motion of the wing, but that in certain circumstances the critical airspeed for wing flutter may be reduced slightly by a coupling with an unstable power-plant whirl mode of comparable frequency. Author (ESRO)

N68-29887*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SOUND MEASUREMENTS ON A FULL-SCALE JET-ENGINE INLET-NOISE-SUPPRESSOR COWLING
L. Jack Smith, Loren W. Acker, and Charles E. Feiler Washington Jul. 1968 27 p refs
(NASA-TN-D-4639) CFSTI: HC $3.00/MF $0.65 CSCL 21E

Several prototype suppressors were ground tested on a jet engine. Broadband resonant absorbers were used as the acoustic absorption treatment. Inlet geometries included both acoustically treated struts and a circumferential splitter ring. Results of calculations on far field noise data showed a maximum total sound power reduction of 10.2 decibels and simulated flyover noise reductions up to 10.5 perceived noise decibels. Strut geometries were best for sideline noise reduction, but the splitter configuration, with the most treated surface areas, achieved the greatest sound power reduction. A mathematical model of sound power attenuation correlated with the data. Author

N68-29892# National Physics Lab., Teddington (England). Aerodynamics Div.
DISTORTION OF SONIC BANGS BY ATMOSPHERIC TURBULENCE
S. C. Crow 11 Mar. 1968 65 p refs
(NPL-AERO-1260, ARC-30009; AD-834141)

A scattering theory is developed to explain the spiky perturbations behind N-wave shocks. All levels of the atmospheric boundary layer contribute to the scattering, according to the theory, and eddies in Kolmogorov's inertial subrange are the main source of the spikes. The theory relates the mean-square pressure perturbation, at any time after the passage of a shock, to meteorological and flight conditions. Author (TAB)

N68-29980 Eidgenossisches Flugzeugwerk Emmen (Switzerland).
UNDERCARRIAGE LOADINGS OF THREE AIRCRAFT: PORTER PC 6, VENOM DH-112 AND MIRAGE 3 S
Jean-Pierre Weibel [1967] 31 p refs Presented at the 5th I.C.A.F. Symp. on Aircraft Fatigue—Design, Operational and Economic Aspects, Melbourne, 22–24 May 1967

Load measurements on the undercarriage and main structure of these aircraft on the ground and during flight are described. The purpose of these measurements was to gain statistical values of ground load spectra for a fatigue test and to assess load assumptions calculated following the design requirements for aircraft. Differences in the loads are examined for landings on concrete or grass runways. Recommendations are made regarding undercarriage loads and their consideration in fatigue tests. K.W.

N68-30038# Aeronautical Research Labs., Melbourne (Australia).
THE DEVELOPMENT OF A SEAT CUSHION FOR ATTENUATING VERTICAL FORCES TRANSMITTED TO THE SPINE IN AN AIRCRAFT CRASH
A. P. Vulcan and S. R. Sarrailhe Jul. 1967 39 p refs
(ARL/SM-316) CFSTI: HC $3.00/MF $0.65

The human body tolerance to headward and vertical acceleration relative to design of an energy absorbing seat cushion is discussed. A mass-spring system analogue is referenced in viewing the dynamics of the human body when subjected to vertical acceleration. A tolerance curve from this analogue partially agrees with values from earlier experimental studies. Equations are derived for the allowable impact velocity in terms of aircraft acceleration and seat cushion characteristics. Three types of cushion are considered in the calculations: one which compresses at a constant force, one with slack, and one which exerts a force proportional to the deflection. Seat cushion design criteria include body weight range supported by seat, seating area, and cushion materials. Test rigs, procedures, and test results for cushion materials are described. Conclusions are that a cushion of suitable characteristics will attenuate large upward accelerations which may occur in an aircraft crash and reduce probability of spinal injury. Such a cushion would consist essentially of a crushable material, such as a 4-inch thick block of rigid polyurethane foam between two load spreader plates with sheet metal shear webs of negligible vertical stiffness to resist horizontal forces. D.H.B.

N68-30109# MSA Research Corp., Evans City, Pa.
EVALUATION OF THE DUST CLOUD GENERATED BY HELICOPTER ROTOR DOWNWASH Final Report, Oct. 1965–Jul. 1967
Sheridan J. Rodgers Mar. 1968 35 p refs
(Contract DA-44-177-AMC-289(T))
(USAAVLABS-TR-67-81; AD-669676)

The dust cloud generated by a tandem-rotor H-21 helicopter was studied as a function of type of soil, hover height and disc loading. A total of 98 tests were made, and three different test sites were used. Samples were collected at 25 locations on the helicopter. Analyses were made for dust content and particle size

distribution. Average dust concentrations at the area of highest dust density, i.e., at rotor blade overlap, are given. The highest concentrations were measured at the site of rotor blade overlap, and the lowest concentrations were found beneath the rotor hubs. The maximum particle size decreased with increasing elevation. No particles over 500 microns were found at any elevation. Dust concentrations of 40 mg/cu ft were measured during takeoff and approach maneuvers. With another helicopter hovering in the immediate area, concentrations of 64 mg/cu ft were measured.
Author (TAB)

N68-30129# Advisory Group for Aerospace Research and Development, Paris (France).
V/STOL APPROACH AND LANDING SYSTEMS
1967 34 p refs
(AGARD-560) CFSTI: HC $3.00/MF $0.65

This report presents the results of a survey sponsored by the AGARD flight mechanics and avionics panels on the practicalities of providing approach and landing guidance for V/STOL aircraft in accordance with the recommendations of AGARD Report VLS'65. While specific equipments have been examined, the findings are framed in terms of general system types and should be interpreted as such.
Author

N68-30182# Aeronautical Systems Div., Wright-Patterson AFB, Ohio. Dynamics Branch.
GUIDELINES FOR ESTABLISHING INTERIOR NOISE LEVEL CRITERIA FOR AIR FORCE AIRCRAFT
John H. Wafford Mar. 1968 24 p refs
(SEG-TR-67-57; AD-670165)

Guidelines are presented to assist the engineer in developing interior noise level criteria for Air Force procured aircraft. The shortcomings of Air Force documents used in establishing interior noise level requirements are pointed out. Speech communication, annoyance and fatigue, and damage-risk, and their relationship to specific noise level requirements, are discussed. Based on these noise environmental factors and Air Force requirements, interior noise level criteria are developed for various types of aircraft.
Author (TAB)

N68-30228*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
CAPACHE PAYLOAD RECOVERY SYSTEM
Dec. 1967 35 p *Its* Serv. Manual Part No. SGC-856-SM2
(NASA-TM-X-63277; X-721-67-552) CFSTI: HC $3.00/MF $0.65 CSCL 01C

Reported is a technical manual which is designed to provide servicing and adjustment instructions for the Capache system used to recover the payload of small diameter sounding rockets of the Nike-Cajun or Nike-Apache class. Included is a description of the assemblies and components of the recovery system; procedures for the initial checkout and adjustment of the recovery system; and field procedures which must be performed before mating the recovery system to the payload and rocket. Included are appendixes which contain sample data sheets and parts list and specifications.
S.C.W.

N68-30249# Weapons Research Establishment, Salisbury (Australia).
A SERVO POWER AMPLIFIER FOR JINDIVIK CONTROL SYSTEMS
M. F. Penny Jan. 1968 19 p refs
(WRE-TM-ISD-121) CFSTI: HC $3.00/MF $0.65

A solid state saturating servo power amplifier (SPA) is described for use as a replacement for the heavy duty relays in Jindivik aileron and bang–bang control systems; and resulting servo loop characteristics are also considered. The SPA was designed to facilitate retrospective fit in the amplifier unit of the autopilot; and one SPA unit is required for each of the two control channels. Because the SPA exhibits fast switching time compared to the relay it replaces, the amplifier permits modifications of the differential switch and magnetic amplifier to improve overall loop characteristics.
M.W.R.

N68-30263* National Aeronautics and Space Administration, Washington, D. C.
SIMPLIFIED LONGITUDINAL-STABILITY ANALYSIS FOR A GLIDER IN TOWED FLIGHT [UPROSZCZONA ANALIZA STATECZNOSCI PODLUZNEJ SZYBOWCA W LOCIE HOLOWANYM]
Jerzy Maryniak Jun. 1968 54 p refs Transl. into ENGLISH from Mech. Teoretyczna i Stosowana (Poland), v. 5, no. 1 p 57–101
(NASA-TT-F-11760) CFSTI: $3.00 CSCL 01C

Discussion of the longitudinal stability of a rigid glider towed by an aircraft in straight horizontal steady flight. The configuration of the towing rope under the effect of aerodynamic forces is established, together with the equilibrium conditions of the glider. The range of angles formed by the towing rope and the corresponding lift coefficients are calculated. A stability analysis performed by a small perturbation technique leads to a sixth-order characteristic equation, the roots of which may be determined by the Bairstow method. The results indicate that the towing process does not affect the high frequency oscillations but does enhance the fugoidal oscillations. To reduce the latter effect, it is essential to fly the glider below the level of the towing craft and to attach the towing rope in front and above the glider's center of gravity.
Author

N68-30306*# National Academy of Sciences-National Research Council, Washington, D. C. Aeronautics and Space Engineering Board.
CIVIL AVIATION RESEARCH AND DEVELOPMENT—AN ASSESSMENT OF FEDERAL GOVERNMENT INVOLVEMENT
Aug 1968 76 p refs
(Contract NSR-09-012-912)
(NASA-CR-95879) CFSTI: HC $3.00/MF $0.65 CSCL 01B

The impact of civil aviation on the United States economy and on the public is examined in terms of past trends and future potential, and the three most critical factors affecting growth forecasts are identified as airport and support facilities, noise, and air traffic control. The role of the Federal Government is considered, and the strong recommendation is made that the Department of Transportation should provide leadership in conducting system studies to identify, analyze, and rank civil aviation goals as well as the research and development needed to attain these goals; NASA should be responsible for research and development in civil aeronautics; and FAA should be responsible for systems testing of the resulting operational concepts and hardware, in addition to operating the airways network. Summary data are provided on the detailed recommendations pertaining to the application of systems analysis methods to the civil air transportation system; flight vehicles and air breathing propulsion technologies; aircraft operations problems; air traffic control; and development and planning of airport and support facilities.
M.G.J.

N68-30370 British Aircraft Corp., Filton (England).
THE DEVELOPMENT AND TESTING OF CONCORDE STRUCTURE FROM NOISE ASPECTS
D. C. G. Eaton Mar. 1968 18 p refs
(SST/B74S-7/2966)

Structural acoustics problems in design and development of supersonic aircraft are recognized, and a program is outlined to resolve these problems in the development of the Concorde supersonic civil aircraft. Theoretical and experimental investigations to

obtain noise loading action characteristics are outlined. Structural noise characteristics such as jet noise, intake noise, and engine bay noise will be obtained from the prototype aircraft which has been instrumented for this purpose. Typical examples of structural problems and associated economic considerations are described. General factors and procedures for an extensive acoustic fatigue test program are presented. Noise problems associated with passenger and crew comfort requirements are considered and are expected to compare favorably with current subsonic transport aircraft. D.H.B.

N68-30391# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

EQUIPMENT FOR FLIGHT VIBRATION TESTS OF THE SST CONCORDE [APPAREILLAGE D'ESSAIS DE VIBRATION EN VOL DE L'AVION CONCORDE]

Gerard Piazzoli 1967 29 p refs In FRENCH; ENGLISH summary

(ONERA-NT-120) CFSTI: HC $3.00/MF $0.65

Vibration testing equipment was developed to study the aeroelastic behavior of the SST Concorde, which exhibits structural flexibility and is subjected to severe environments during flight. The equipment includes 19 seismic electrodynamic exciters of four types that are located on the wind, on the tail, and in the fuselage. Qualification tests of the equipment were made with a dynamic balance to simulate the elasticity of the aircraft and the most critical environment. Safety and reliability requirements were considered during the testing, and experimental results were in close agreement with predicted values for the equipment. Details are included for the equipment, the dynamic balance, and the development of the exciters and their performance. Transl. by M.W.R.

N68-30398*# Techtran Corp., Glen Burnie, Md.

THE PROBLEM OF GLIDER TAKEOFF USING A TOW WINCH [ZAGADNIENIE STARTU SZYBOWCA ZA WYCIAGARKA]

A. Jensen and W. Lehman Washington NASA Jun. 1968 11 p Transl. into ENGLISH from Tech. Lognicza i Astronautyczna (Warsaw), v. 22, Sep. 1967 p 11–16

(Contract NASw-1695)

(NASA-TT-F-11759) CFSTI: HC $3.00/MF $0.65 CSCL 01C

Theoretical and experimental analysis of the mechanics of glider takeoff using a tow winch, with particular consideration of the loads applied to the glider. The glider's flight path at takeoff is examined during three different phases: (1) sliding or rolling over the ground till the moment of lift-off, (2) transition into climbing flight, and (3) climbing flight until the instant of release. The length of the first phase is determined in terms of the necessary air speed. The force exerted by the winch is studied in relation to ground friction and forces present in the towing cable. The lengths of the subsequent phases are similarly considered, and the effects of cable shape are studied. The equilibrium of forces acting on the glider is outlined in terms of the aerodynamic force, the gravitational force, and the towing force. Flight speeds and towing forces are experimentally determined for two different gliders and tow winches. Author

N68-30465# McGill Univ., Montreal (Quebec). Mechanical Engineering Research Labs.

THE PERFORMANCE OF PROPELLERS OPERATING AT ZERO ADVANCE RATIO

David C. Gilmore (M.S. Thesis) Sep. 1967 124 p refs

(Rept.-67-9; AD-669653)

The thesis is concerned with methods of predicting the performance, that is, the overall thrust and power, of air propellers operating at zero advance ratio. Measurements from two such propellers, often called static thrust propellers because they are designed to operate at zero forward speed, are used as a basis for evaluating the following performance prediction methods: the modified Lock - Goldstein method, and the Gartshore - Gray method. Both prediction methods give fairly good estimates of overall thrust. The former method gives a poor radial distribution of thrust while that of the latter method is relatively good. Conventional strip analysis is also evaluated using measured inflow velocities and while agreement between theory and experiment can be excellent it is conditional upon the assumptions made with respect to blade section characteristics and the use of tangential inflow velocity. Author (TAB)

N68-30493# Aeronautical Research Inst. of Sweden, Stockholm.

ATMOSPHERIC MAGNIFICATION OF SONIC BOOMS IN THE OKLAHOMA TESTS

Bo K. Lundberg, Robert F. Dressler, and Sven Lagman Jun. 1967 18 p refs

(FFA-112) CFSTI: HC $3.00/MF $0.65

By subjecting the Oklahoma City test data to further analysis, some new results of significance have been obtained. Distribution curves must first be adjusted to actual median values produced by the flights, and an absolute magnification calculated from the reported local magnifications. Then two clear trends can be exhibited: size of magnifications depends upon cruising altitude, and superbooms tend to occur at the carpet edges, in agreement with theory. The concepts of total wave energy and transferred energy and the magnifications are discussed, with specific reference to large SST's. Author

N68-30587 Southampton Univ. (England). Audiology and Human Factors Group.

A COMPUTER METHOD FOR ANALYSING AND EVALUATING THE SPECTRA AND LOUDNESS OF SONIC BOOMS

C. B. Pease and A. R. D. Thornton [1968] 10 p refs

CFSTI: $3.00

A procedure was developed which calculates the loudness of transient sounds, from their time-pressure waveforms. The procedure was arranged to give a computer method for evaluating the spectra and loudness of sonic booms and similar transients. This method uses the technique of variable interval sampling, which reduces the number of data points required to characterise the waveform. It is to be shown that, when calculating the loudness in phons of a sonic boom, approximations can be made which further reduce the number of data points necessary, and hence considerably ease the task of data compilation. Author

N68-30792* Institute of Modern Languages, Inc., Washington, D. C.

THEORY OF THE SUPERSONIC BOOM BASED ON THE NONLINEAR THEORY OF SHORT WAVES [LA THEORIE DU BANG SUPERSONIQUE D'APRES LA THEORIE NONLINEAIRE DES ONDES COURTES]

Jean-Pierre Guiraud Washington NASA Jun. 1968 28 p refs Transl. into ENGLISH of the ONERA Report, Oct. 1967 p 1–22 Presented at the Franco–German Colloq. on Supersonic Booms, St. Louis, 18–20 Oct. 1967

(Contract NASw-1693)

(NASA-TT-F-11474; ONERA-TP-521) CFSTI: $3.00 CSCL 01B

The author investigates the origin of supersonic boom and its relation to several elementary phenomena. He shows the governing elements in the sonic perturbation and the corresponding condition of shock interpreted in terms of velocities. The nonlinearity effect is contemplated by reducing it to a phenomenon of convection along the rays of the acoustic approximation. Abundant literature on the supersonic boom is discussed. Author

N68-30793# Weapons Research Establishment, Salisbury (Australia).
PERFORMANCE TRIALS OF HIGH ALTITUDE METEOROLOGICAL PARACHUTES
G. J. Simpson Jan. 1968 46 p refs
(WRE-TN-SAD-169) CFSTI: HC$3.00/MF$0.65

Two operational trials in the development of a high altitude parachute for use with a meteorological dropsonde are described and the results analysed for estimates of parachute deployment, drag and stability performance. Successive design modifications of the parachute to achieve the required stability are indicated. Author

N68-30795*# National Aeronautics and Space Administration, Washington, D. C.
HANDLING QUALITIES OF HELICOPTERS WITH ELASTICALLY ATTACHED ROTOR BLADES [FLUGEIGENSCHAFTEN BEI HUBSCHRAUBERN MIT ELASTISCH ANGESCHLOSSENEN ROTORBLATTERN]
G. Reichert Jul. 1968 29 p refs Transl. into ENGLISH from Jahr. 1963 Wiss. Ges. Luftfahrt (Berlin) p 136–149
(NASA-TT-F-11374) CFSTI: HC$3.00/MF$0.65 CSCL 01D

A comprehensive and systematic investigation of the flight behavior of helicopters with elastically attached blades is described, with mathematical formulas for stability and control conditions and diagrams on vibration, frequency, phase shifts, and flapping angles for longitudinal and lateral motion. A theory is developed for comparison of helicopters with rigidly attached elastic rotor blades and articulated blade attachment, using equivalent rigidity models of the flapping hinge. Stability characteristics are improved with increasing rigidity. Aside from the driving torque, no rotor movements act on the rotor center with free flapping hinges and zero flapping hinge offset, but the rotor moments contribute greatly to the characteristics of stability and control of rotors with flapping hinges of great stiffness and large offset. The effect of articulatory stiffness on stability and control is illustrated on the example of hovering flight. Author

N68-30822# Southampton Univ., (England). Inst. of Sound and Vibration Research.
STRUCTURAL VIBRATIONS CAUSED BY PRESSURE FLUCTUATIONS IN THE AUDIO FREQUENCY RANGE
B. L. Clarkson Feb. 1968 34 p refs Presented at the Symp. on Aeron. Acoustics, Toulose, 6–8 Mar. 1968
CFSTI: HC$3.00/MF$0.65 CSCL 01B

High frequency, low amplitude, random pressure fluctuations arising from jet noise, turbulent boundary layers, and vortex flows were studied to determine the effects of acoustic and other high frequency pressure fluctuations on the surface of aircraft and missiles. Since previous experience of significant vibration resulting from high frequency pressure fluctuations has been in regions where jet noise has formed the predominant source, and on the basis of results obtained from studies which indicated that the greatest vibration levels due to jet noise have occurred most frequently in skins, along rivet lines, and at the rivet holes or bend radii of attachment brackets joining the stiffened skin to frames or ribs, studies of skin and rib vibration were undertaken. Focused on were single skins stiffened with stringers. Discussed are the stress response of typical structures to jet noise at take off, and the recently observed phenomenon of shock cell noise which can give in-flight stress levels as high as or even higher than the levels produced by the maximum engine thrust on the ground. A simplified theory of response of structures to jet noise is developed and its applicability in the analysis of single mode responses, flat plates excited by random acoustic pressures, and control surfaces where two skins are attached by ribs and thus both skins and ribs vibrate because of the mechanical coupling between them, is discussed. S.C.W.

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N68-29960*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL EVALUATION OF A VOLTAGE REGULATOR-EXCITER FOR A 15 KILOVOLT-AMPERE BRAYTON CYCLE ALTERNATOR
Gary Bollenbacher, Richard A. Edkin, and Dennis A. Perz Washington Aug. 1968 31 p refs
(NASA-TN-D-4697) CFSTI: HC$3.00/MF$0.65 CSCL 10A

A voltage regulator–exciter for a 15 kVA, 120/208 volts, 400 hertz alternator was experimentally evaluated. Emphasis was placed on the effect of the voltage regulator–exciter on the alternator performance. Specific items tested include the voltage regulator–exciter output capacity, its regulating capability, its effect on alternator waveshape, and its performance during transient and startup conditions. Author

N68-30002*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
PERFORMANCE CHARACTERISTICS OF 15 kVA HOMOPOLAR INDUCTOR ALTERNATOR FOR 400 Hz BRAYTON-CYCLE SPACE-POWER SYSTEM
Richard A. Edkin, Martin E. Valgora, and Dennis A. Perz Washington Aug. 1968 40 p refs
(NASA-TN-D-4698) CFSTI: HC$3.00/MF$0.65 CSCL 10A

The measured performance of a 15 kVA homopolar inductor is presented and compared with design goals. Test results include alternator saturation, voltage unbalance, harmonic analysis, short circuits, machine reactances, and time constants. The following overall performance was obtained: maximum continuous output, 22.5 kVA; peak efficiency, 0.918 at 11.25 kVA; and efficiency at rated 15 kVA output, 0.915. Author

N68-30014# Pratt and Whitney Aircraft, West Palm Beach, Fla. Research and Development Center.
DESIGN AND EVALUATION OF A HIGH TEMPERATURE RADIAL TURBINE Quarterly Technical Progress Report, 1 Feb.–30 Apr. 1968
G. S. Calvert May 1968 38 p
(Contract DAAJ02-68-C-0003)
(PWA-FR-2806; QTPR-3; AD-669664)

The objective of the contract is to develop a technology for high temperature radial turbines to a level that will permit a potential small-engine-manufacturer to make a choice between the radial and the axial turbine. The double-pass rotor design was adopted as the preferred rotor configuration for the turbine. Aerodynamic refinement of the turbine continued. Aerodynamic analysis of the cold flow rotors was completed, and the analytical conclusions drawn from these analyses were confirmed by cold flow tests, which are now 80% complete. Water rig testing was completed, and results indicated the type of losses associated with tip ejection of the rotor cooling air. Steady-state heat transfer analyses were completed, and transient heat transfer studies are now in progress. Metallurgical testing of the rotor specimens is now 80% complete; observed tensile properties are satisfactory, but creep-rupture properties continue to be low. Author (TAB)

N68-30197*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
LOW INPUT VOLTAGE CONVERSION-REGULATION FROM UNCONVENTIONAL PRIMARY AND SECONDARY SOURCES
Edward R. Pasciutti Jan. 1968 55 p refs
(NASA-TM-X-63118; X-716-68-49) CFSTI: HC $3.00/MF $0.65 CSCL 10B

The principal results are presented of studies and circuit development in the area of low input voltage conversion-regulation (LIVCR) from unconventional primary (radioisotopic fueled thermoelectric generators) and secondary (battery) sources. An analysis was made of the source, converter, and load interrelationships for power-limited primary sources and low impedance secondary sources. A circuit technique to improve low input voltage inverter crossover reliability, efficiency, and source ripple, by optimizing inverter full-cycle base driving conditions was developed. A configurational current feedback driven inverter approach, which protects against output transformer saturation destructive current surges, was developed which has important use for low impedance source LIVCR applications. To confirm the analysis, applications demonstrating the design approaches are presented along with waveform and numerical data. It is shown that the combining of sources each with radically different output characteristics can be functionally-integrated into a power system using the dc to dc converter-regulators specially developed, which provide conditions operationally suitable to each source subsystem while enhancing the reliability and efficiency of the overall power supply system. Author

N68-30241*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COLD-AIR INVESTIGATION OF EFFECTS OF PARTIAL ADMISSION ON PERFORMANCE OF 3.75-INCH MEAN-DIAMETER SINGLE STAGE AXIAL-FLOW TURBINE
Hugh A. Klassen Aug. 1968 22 p ref
(NASA-TN-D-4700; E-4407) CFSTI: HC $3.00/MF $0.65 CSCL 21E

Total to static efficiency is described as a function of percentage of admission and blade-jet speed ratio. At design blade-jet speed ratio, efficiency decreased from 0.68 to 0.56 as percentage of admission was reduced from 100 to 11.76. Partial admission efficiency losses are divided into rotor pumping and windage losses and all other losses. Author

N68-30318*# Biometrics Instrument Corp., Plano, Tex.
STUDY OF STATE-OF-THE-ART STATIC INVERTER DESIGN Final Report, 6 Jan.–6 Jun. 1966
C. L. Payne, M. G. Warford, D. C. Nipper, J. P. Smith, and J. D. Gillett 16 Jun. 1966 187 p refs
(Contract NAS9-5580)
(NASA-CR-92200; VARO-VSPER-0005) CFSTI: HC $3.00/MF $0.65 CSCL 10A

Current static inverter designs are reviewed in order to develop an advanced design for a multiple-purpose inverter. Ten basic inverter design circuits are assessed: the parallel inverter, chopper regulated parallel inverter, series connected parallel inverter, bridge inverter, step-wave inverter, high frequency step-wave inverter, high frequency dc–ac converter–inverter, pulse-width modulated inverter, and phase-demodulated inverter. The phase-demodulated high frequency inverter type is selected since it offers a maximum weight reduction with a minimum of power and control circuitry among other advantages. The selected design is explained in detail. The circuit is analyzed and basic circuit components are selected. The preliminary circuit diagram and a proposed bill of materials is developed. System performance and physical characteristics are established by a detailed loss, or efficiency-and-weight, study. Design goals are defined in terms of efficient, weight, dimensions, acoustic noise and reliability. Design requirements are specified as mission, safety factor, electrical characteristics, mechanical characteristics, and environmental characteristics. A bibliography and detailed parts list are included. D.H.B.

N68-30424# Harry Diamond Labs., Washington, D. C.
AN ANGULAR POSITION SERVO FOR LARGE MOMENTS OF INERTIA
Ephraim W. Hogue Feb. 1968 48 p refs
(HDL-TM-68-5; AD-669743)

Graphs and equations are derived to help the designer in the selection and use of an electric servomotor for positioning a large pure rotational inertia when the amplitude, bandwidth, and accuracy of the motion are specified. The motor forms part of the loop of a type I servo. The factors that make up the velocity constant Kv and the torque constant KT are obtained; and a method for stabilizing the closed loop is given. The saturation response to a large step-function command is derived, and a dual gain mode of operation for minimizing the saturation overshoot is described. Author (TAB)

N68-30443# General Motors Research Labs., Warren, Mich.
INVESTIGATIONS ON THE DIRECT CONVERSION OF NUCLEAR FISSION ENERGY TO ELECTRICAL ENERGY IN A PLASMA DIODE, VOLUME 1 Final Report, 1 Nov. 1966–31 Oct. 1967
Charles B. Leffert and David B. Rees 29 Feb. 1968 204 p refs
(Contract Nonr-3109(00))
(GMR-767; FR-8; AD-670469)

This is the unclassified section (Vol. I) of the Final Report dealing with fission-fragment-generated plasmas for thermionic energy conversion. Results of the past years work are presented under three major headings, viz., (A) - Reaction Kinetic Studies of Ar-Cs Plasmas, where the possible influence of a heteronuclear ArCs+ ion is considered and rejected; (B) - Calculation of Electron Temperatures in Plasmas Produced by Fission Fragments, where we discover that a non-equilibrium electron temperature exists at the higher values of neutron flux; and (C) - Electron Densities in Fission-Fragment-Induced Plasmas in Microwave Cavities, where much of our previous theories are collected, enlarged and incorporated into a comprehensive set of computer codes which predict accurately electron densities in the Ne-Ar system. Preceding the detailed discussion of these 3 topics is a summary of the main results of studies (A), (B), and (C). Also we survey our past work and offer some general comments and conclusions on the present status and utility of the fission-fragment ionization scheme for use in thermionic diodes. Author (TAB)

N68-30490# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AN ASYMPTOTIC METHOD FOR COMPUTING THE TEMPERATURE FIELD OF GAS TURBINE MOVING BLADES [K ASIMPTOTICHESKOMU METODU RASCHETA TEMPERATURNOGO POLYA RABOCHIKH LOPATOK GAZOVYKH TURBIN]
I. S. Lyubchenko 18 Aug. 1967 17 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii. Aviats. Tekhn. (Kazan), no. 2, 1965 p 92–102
(FTD-HT-67-40; AD-670096)

An approximate solution was obtained for the boundary problem of unidimensional stationary heat conductivity. This solution enables computations to be carried out with a high degree of accuracy. The working blade of a turbine in a non-uniform temperature gas field is considered, on the assumption that the blade temperature through the section and along the profile contour (at any radius) is held constant, and that the heat emission factor

along the contour of each cylindrical section is also constant. The heat balance equation is converted into a differential equation and boundary conditions are assigned. Formulae are derived for the solution of the boundary problem and, in the second section of the article, an effort is made to represent this solution in an asymptotic form. A final asymptotic expression is thus obtained and estimated, with an example given illustrating how it can be employed in a practical calculation of blade temperature fields. Author (TAB)

N68-30506*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF A VARIABLE STATOR AREA ON PERFORMANCE OF A SINGLE-STAGE TURBINE SUITABLE FOR AIR COOLING. 2: STATOR DETAILED LOSSES WITH 130 PERCENT DESIGN AREA
Thomas P. Moffitt, Herman W. Prust, Jr., and Bernard Bider Washington Aug. 1968 21 p refs
(NASA-TM-X-1635) CFSTI: HC $3.00/MF $0.65 CSCL 21E

The turbine is being investigated at stator area settings of 70, 100, and 130 percent of design. The experimental and analytically predicted results are presented for the stator having open (130 percent) area setting and compares these results with similar results obtained for the design (100 percent) area setting. The final results are presented in terms of kinetic energy loss coefficients as a function of velocity level. The experimental losses were close to those predicted analytically and indicate a stator efficiency of about 96 percent. Author

N68-30521# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EXPERIENCE IN DESIGN OF A LOW-TEMPERATURE HELIUM TURBINE REFRIGERATOR [OPYT KONSTRUIROVANIYA NIZKOTEMPERATURNOGO GELIYE-VOGO TURBODETANDERA]
V. M. Kulakov 1 Sep. 1967 10 p Transl. into ENGLISH from Khim. i Neft. Mashinostr. (USSR), no. 5, 1964 p 8–10
(FTD-HT-67-227; AD-670065)

The shaft has two cantilevers. The impeller is on the left cantilever and the gas brake is on the right. The impeller at the input side has a 52 mm diameter with 14 vanes at angles of 24 degrees. The number of vanes at the discharge side is half as many at angles of 35 degrees. The impeller is made of anodized dural. The bearings consist of two radial and one double-action axial supports. The shaft is made of 1Kh18N9T steel. The turbo-expander is mounted in a cylindrical block with powder-vacuum insulation. The speed of the machine was measured by a magnetic meter. The pick-up unit is a steel nut encircled by an electromagnet. The actual efficiency was 0.53 due to the lower speed. The best way of increasing the speed is by the use of a small piston compressor on the supply line. Author (TAB)

N68-30535# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DESIGN AND CONSTRUCTION OF MECHANICAL INJECTORS [RASCHET I KONSTRUIROVANIYE MEKHANICHESKIKH FORSUNOK]
V. A. Pavlov and Ya. P. Storozhuk 15 Sep. 1967 23 p refs Transl. into ENGLISH from Energomashinostroenie (Moscow), no. 3, 1966 p 8–11
(FTD-MT-67-28; AD-670089)

A method of combined hydraulic and dispersion design of mechanical injectors is proposed which permits determination of basic geometric parameters of an atomizer: diameters of nozzle and turbulence chamber, area of tangential channel, and number of tangential channels. Author (TAB)

N68-30663*# Honeywell, Inc., Montgomeryville, Pa. Ordnance Div.
DEVELOPMENT OF HIGH ENERGY DENSITY PRIMARY BATTERIES Topical Report
S. G. Abens Jan. 1968 30 p refs
(Contract NAS3-10613)
(NASA-CR-72416) CFSTI: HC $3.00/MF $0.65 CSCL 10C

Studies of discharge properties of thin plate CuF_2-Li cells with MF-$LiClO_4$ electrolyte were undertaken. Seven plate, 4–5 AH (theoretical) cells were discharged at -5°C and +35°C at five rates giving current densities in the range of 1.2 to 34.5 mA/cm^2. At -5°C, 63.3% CuF_2 reduction efficiency and 106 wh/lb of net cell was obtained at 8.6 mA/cm^2 (ca. 3-hour rate); at 35°C, the corresponding figures were figures were 61.9% and 106 wh/lb at 3.0 mA/cm^2 (ca. 8-hour rate). Author

N68-30677# Thermo Electron Engineering Corp., Waltham, Mass.
RESEARCH AND DEVELOPMENT OF VACUUM FOIL-TYPE INSULATION FOR RADIOISOTOPE POWER SYSTEMS Quarterly Progress Report, Dec. 1967–Feb. 1968
J. Carvalho, J. B. Dunlay, J. Fronduto, M. L. Paquin, and V. L. Poirier 31 Mar. 1968 66 p
(Contract AT(30-1)-3634)
(ALO-3634-8; TE-4059-121-68) CFSTI: HC $3.00/MF $0.65

Work on the development of high-temperature thermal insulation for radioisotope power systems is reported. Thirteen planar insulation samples were fabricated and eight of these tested in the planar heat loss test apparatus. The purpose of these tests is to evaluate the effectiveness of various spray coatings. Approximately 200 feet of tungsten foil was chemically etched from a thickness of 1.3 to 1.4 mils to a thickness of .3 to .4 mil. Six-inch wide tungsten foil cannot normally be purchased in thicknesses less than 1 mil. Slit-cup, overlap, and tapered corner assemblies were fabricated and tested in the edge heat loss test apparatus. The tapered corner was the most effective. The compatibility testing of aluminum, copper, nickel, and platinum foil in combination with alumina and zirconia is in progress. After 100 hours, zirconia appears to produce the least bonding between foil layers. Author (NSA)

N68-30881# Utah Univ., Salt Lake City. Microwave Device and Physical Electronics Lab.
INVESTIGATION OF SYNCHRONOUS-WAVE RF TO DC CONVERSION Final Report, 1 Jun. 1966–31 Dec. 1967
D. C. Watson, R. W. Grow, and C. C. Johnson Apr. 1968 207 p refs
(Contract DA-28-043-AMC-02290(E))
(Rept.-4; UTEC-MD-68-006; ECOM-02290-F; AD-670083)

A device for converting microwave power into electrical power in either d-c or low frequency a-c form is investigated both theoretically and experimentally. An electron beam passes through a Cuccia coupler where it receives microwave power in the form of cyclotron rotation, then enters a region of decreasing magnetic field which accelerates the beam along the axis of rotation. The increased longitudinal kinetic energy is recovered as electric energy by a depressed collector. A simple kinematic analysis demonstrates that the Cuccia coupler can convert large amounts of microwave power into electron beam rotation. Although the inertial mass increase introduces some difficulties in Cuccia coupler operation, these difficulties are surmountable, and satisfactory coupler operation can be achieved for a relatively wide range of operating conditions. In most cases, relativistic operation is superior to that predicted classically. Four tubes and a gun-collector tester prototype were tested experimentally. The gun-collector tester prototype gave efficiencies from 36 percent to 75 percent. A fourth tube yielded measured efficiencies up to 34 percent, or when corrected to disregard cavity losses, up to 59 percent. Author (TAB)

N68-30704# Westinghouse Electric Corp., Lima, Ohio. Aerospace Electrical Div.
REPORT PARAMETRIC STUDY OF INDUCTOR ALTERNATORS. DESIGN STUDY ELECTRICAL COMPONENT TECHNOLOGY FOR 0.25 TO 10.0 MEGAWATT SPACE POWER SYSTEMS. PARAMETRIC STUDY OF INDUCTOR ALTERNATORS
C. C. Kouba Feb. 1968 249 p refs
(Contract AT(04-3)-679)
(SAN-679-6) CFSTI: HC $3.00/MF $0.65

Parametric studies to determine minimum system weight as a function of electrical rating, frequency, speed, voltage, and coolant temperature are presented on inductor alternators for ratings of 0.25 to 10.0 megawatts for space nuclear electric power plants utilizing the Rankine conversion cycle. Author (NSA)

N68-30713# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
DODGE SATELLITE POWER SYSTEM
Louis Wilson May 1968 39 p
(Contract NOw-62-0604-c)
(TG-978; AD-669994)

The DODGE (Department of Defense Gravity Experiment) satellite was launched on July 1, 1967 to an altitude of 18,000 statute miles into a near-synchronous orbit. The satellite was designed, as an experiment to demonstrate two- and three-axis gravity-gradient stabilization using magnetic and hysteresis damping techniques. A solar cell/battery power system furnishes all of the electrical energy required to operate the satellite subsystems. The solar power generating capability is 45 watts (average). A 6-ampere-hour 10-volt nickel-cadmium battery operates peak electrical loads during light and dark orbits as required. DC-to-AC inverters and DC-to-DC converters transform the solar/battery voltage to the proper levels required to operate the on-board electrical loads. The power system contains protective devices for safeguarding the battery against excessive discharge currents and charging voltages. Author (TAB)

N68-30716# Naval Avionics Facility, Indianapolis, Ind. Technical Evaluation Dept.
EVALUATION OF REWRAPPED SOLDERLESS WRAPPED CONNECTORS
Richard I. Coy 9 Oct. 1967 22 p
(NAFI-TR-1092; AD-669984)

A typical one-row, 0.20 inch centers, Polaris MK 84 Fire Control Type 2 Module (hereinafter referred to as the Testplate) wired with No. 18 AWG and No. 24 AWG wire and numerous individual wrapped connections wrapped with No. 18 AWG and No. 24 AWG wire were used during the evaluation. The Testplate was subjected to Visual Examination, Wrapper Resistance, Thermal Shock, Salt Spray, Vibration, and Current Overload Tests in accordance with Specification OS-11120. The individual wraposts were subjected to Visual Examination, Wrapper Resistance, Wrapper Stripping, Unwrapping, and Gas Tight Area Tests in accordance with Specification OS-11120. The wrapped connections, including those on the Testplate, consisted of wraposts containing the initial wrap, wraposts that had been rewrapped 10 times, and wraposts that had been rewrapped 25 times. Author (TAB)

N68-30751*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PRELIMINARY ANALYSIS OF A TITANIUM ALLOY HONEYCOMB SOLAR ABSORBER HAVING BLACKENED WALLS
William J. Bifano Washington Aug. 1968 27 p refs
(NASA-TN-D-4727) CFSTI: HC $3.00/MF $0.65 CSCL 18N

A titanium alloy hexagonal honeycomb with blackened walls is considered as an absorber of collimated solar solar energy. Circular cylindrical geometry is assumed for the analysis as an approximation of the hexoganal cell structure. The apparent hemispherical emittance of such an absorber positioned over a black surface is calculated. Results are presented for cell length-to-diameter ratios of from 1 to 7 and cell diameters of 0.25, 0.5, and 1.0 in. (0.635, 1.27, and 2.54 cm, respectively). The collimated incident solar flux is assumed sufficient to attain base surface temperatures of 1860° and 2060° R (1033 and 1144 K). The corresponding weight per unit area of such an absorber is also calculated. Author

N68-30760# California Univ., Livermore. Lawrence Radiation Lab.
CONCEPTUAL DESIGN OF A 10-MW SUB E NUCLEAR RANKINE SYSTEM FOR SPACE POWER
J. H. Pitts, ed., and C. E. Walter, ed. 30 Jan. 1968 43 p refs
(Contract W-7405-ENG-48)
(UCRL-50382) CFSTI: HC $3.00/MF $0.65

The conceptual design of a 10-MWe Rankine system for nuclear-electric space power is described. The system includes a compact nuclear reactor operating at 1650°K. The reactor design is based on uranium mononitride as the fuel, lithium as the coolant, and tungsten-25% rhenium as the structural material. An efficient heat-pipe radiator rejects waste heat at 1100°K. Overall system efficiency is 17.5%. Author (NSA)

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology.

N68-29665 Pennsylvania Univ., Philadelphia.
THE DISRUPTIVE EFFECTS OF UNPREDICTABLE SHOCK
Martin Elias Peter Seligman (Ph.D. Thesis) 1967 123 p
Available from Univ. Microfilms: HC $6.00/MF $3.00 Order No. 67-12802

A review of the effects of electric shock presentations which organisms cannot predict reveals four major findings: 1) Organisms choose signalled over unsignalled shock. 2) Organisms choose immediate over delayed shock. 3) Response-independent shock disrupts behavior more than response-contingent shock. 4) Stomach ulceration may increase with increasing unpredictability of shock. A "safety signal" hypothesis is proposed to unify these findings. When shock is reliably predicted for an organism, the absence of shock (or safety) is also predicted. The disruptive effects of unpredictable shock are attributable to the absence of a safety signal, for when an organism has no predictor of safety it will be in chronic fear. The safety signal explanation of the deleterious effects of unpredictable shock generates many predictions for conditioned emotional response (CER) procedures. These predictions were tested and confirmed in the main experiment of this dissertation, and implications discussed. Dissert. Abstr.

N68-29786 West Virginia Univ., Morgantown.
MYOCARDIAL METABOLIC ADAPTIONS IN RESPONSE TO REPEATED EXERCISE
James Leroy Poland (Ph.D. Thesis) 1967 92 p
Available from Univ. Microfilms: HC $4.80/MF $3.00 Order No. 67-11797

Populations of trained albino rats were produced by daily running on a treadmill. Aerobic activity, measured by oxygen consumption using conventional Warburg techniques, tended to be depressed in heart homogenates from the trained rats. Production of lactic acid by heart homogenates under anaerobic conditions also tended to be depressed in trained animals. However, a more severe training program was needed to produce the depressed anaerobic activity than the depressed aerobic activity. Hearts hypertrophied by 5 days of aortic coarctation did not show the same depressed aerobic activity as that found in the trained heart. Trained animals compared to the untrained showed greater glycogenesis during a 24 hour fast and greater glycogenolysis during 15 minutes of exercise. Change in glycogen concentration occurred predominately in the TCA-soluble glycogen in both trained and untrained animals. This increased activity in trained animals during a physiological stress indicates that the metabolic response of the heart *in vivo* must not be governed by the maximal activity of the myocardium since training tended to depress the maximal activity. Dissert. Abstr.

N68-29813# General Precision, Inc., Glendale, Calif. Librascope Group.
MODELS OF NEUROELECTRIC INTERACTIONS Technical Report, 15 Apr. 1965–15 Jul. 1967
Edwin R. Lewis Wright-Patterson AFB, Ohio AMRL Dec. 1967 152 p refs
(Contract AF 33(615)-2464)
(AMRL-TR-67-132; AD-669574)

The Hodgkin-Huxley descriptions of electrically excitable conductances are combined with Eccles descriptions of synaptic conductances to provide the basis of an electronic analog of nerve cell membrane. A neural simulation facility is constructed, comprising ten pairs of these analogs with associated input and output equipment. A detailed description of the simulation facility is presented, including design philosophy, circuit, system and mechanical details. The simulation facility is used to model spatially distributed neuroelectric phenomena. Significant results include resetting of potentials in integrative regions by spikes generated at a remote site, stable spike synchrony in independently driven, mutually inhibiting distributed neural models, burst formation in mutually exciting neural models, and various nonuniformities of wave shape and velocity in conduction along a distributed axon. In addition, the facility is used in a simulation study of the lobster cardiac ganglion. As results of this study, mechanisms are proposed for ganglion operation and specific neuronal connectivities are predicted. Author (TAB)

N68-29872# Duke Univ., Durham, N. C.
THE EFFECT OF THE LABORATORY SITUATION ON EXPERIMENTAL DISCUSSION GROUPS
Stephen R. Wilson Nov. 1967 40 p refs
(Contract Nonr-1181(11))
(TR-26; AD-669467)

The study attempts to determine the effect of the presence of an observer and the saliency of the experimental task upon laboratory discussion groups. Five groups of five subjects each were assigned to each cell of a two by two design (1. observer present versus observer absent; and 2. task used versus task not used). The observed-task not used condition was designed to resemble the typical experimental situation. The strongest differences were found across the observed-not observed conditions. Observed groups had higher rates of task-oriented interaction and lower rates of task-irrelevant interaction, but no difference was found in actual productivity. Differentiation between the sociometric dimensions of best idea rankings and liking rankings was greater in the not observed condition. This was attributed to the greater variation in interaction content in this condition. The methodological implication of the results is discussed and the results are used to interpret the findings of other studies dealing with the development of experimental discussion groups over time. Author (TAB)

N68-29948*# Massachusetts General Hospital, Boston. Neurophysiology Lab.
A STUDY OF TOPOLOGICAL CHARACTERISTICS IN PATTERN PERCEPTION PHYSIOLOGY IN MAMMALIAN CORTEX
Howard T. Hermann [1968] 19 p
(Grant NGR-22-016-005)
(NASA-CR-95811) CFSTI: HC $3.00/MF $0.65 CSCL 05J

Experimental methods and techniques were developed with the ultimate objective being the simultaneous recording from a number of single neuronal units involved in mediating the perception of a stimulating sensory pattern. Input stimuli are purposely restricted to simple, hand manipulated dark objects (3° to 5°) on a white field, normal sounds, and manual touching. Anesthesia preparations and surgical techniques are discussed, along with the criteria for stereotactic, electrode placement control, micromanipulator and microelectrode designs, and the adaptation of a cross-slide carrier for X–Y stereotactic electrode implantation. The implantation of the plastic guide tube assembly into the cortical region and the removal of the overlying dura are described. The data analysis system plan is outlined, with the capabilities defined as single-channel, assembly language programmed, on-line analysis and display of pulse interval statistics and pulse interval histograms and their moment, post-stimulus histograms, and pulse rate averages. A figure is included to depict a typical recording taken during an initial probing of occipital cortex in the rat. M.G.J.

N68-30021*# National Aeronautics and Space Administration, Washington, D. C.
BLASTOPORE AND SPINA BIFIDA. A COMPARATIVE MORPHOLOGICAL, TERATOLOGICAL STUDY ON MALFORMED FROG'S EGGS [URMUND UND SPINA BIFIDA, EINE VERGLEICHEND MORPHOLOGISCHE, TERATOLOGISCHE STUDIE AN MISSGEBILDETEN FROSCHEIERN]
Oscar Hertwig Jun. 1968 120 p refs Transl. into ENGLISH from Arch. Mikroskop. Anat., V. 39, 1892 p 353–503
(Contract NASw-1695)
(NASA-TT-F-11688) CFSTI: HC $3.00/MF $0.65 CSCL 06C

A comparative morphological, teratological study is presented on malformed frog's eggs. Studies were made of disorders of the fertilization process; disorders in the gastrulation process and the malformations resulting from these disorders. A critical examination and evaluation of the findings are given, and similar malformations in other classes of vertebrates are also discussed. Malformation in the three higher vertebrate classes are studied and the findings are applied to basic questions of vertebrate animal morphology. The coelmic theory and relation of the blastopore to difference forms of malformations are discussed. The conditions under which multiple rediments can arise from a single egg cell are given. Author

N68-30029*# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
EFFECTS OF VISCOSITY AND EXTERNAL CONSTRAINTS ON WAVE TRANSMISSION IN BLOOD VESSELS
Everett Jones, I-Dee Chang, and Max Anliker May 1968 157 p refs
(Grants NGR-05-020-223; NSF GK-537)
(NASA-CR-95802; SUDAAR-344) CFSTI: HC $3.00/MF $0.65 CSCL 06P

The propagation of sounds and pulse waves in the cardiovascular system is subject to strong dissipative mechanisms. A parametric study was conducted of the effects of viscosity on dissipation as well as dispersion of small pressure signals in arteries and veins. A linearized analysis of pressure waves in a cylindrical membrane containing a viscous fluid and having an isotropically viscoelastic wall indicates that there are two families of axisymmetric waves: a family of slow waves and one of fast waves. These two families of waves are examined for: (1) sensitivity to variations in elastic properties of the medium surrounding the

blood vessels; (2) attenuation due to fluid viscosity at different Reynolds numbers; (3) radial and axial displacements; and (4) phase angles between pressure, radial wall displacement, and fluid velocity. The theoretical predictions for an elastic membrane are in good agreement with limited quantitative experimental results for a latex rubber tube. A comparison with in vivo data shows that the dissipation due to fluid viscosity alone cannot account for the observed attenuation and lacks the proper frequency dependence. For physiologically meaningful parameter values and high frequencies, the theoretical analysis confirms that the damping due to blood viscosity is much less than that due to the viscoelasticity of the wall material for both families of waves. K.W.

N68-30074 Iowa State Univ. of Science and Technology, Ames.
DYNAMIC SENSITIVITY LYAPUNOV STABILITY ANALYSIS OF THE HUMAN RESPIRATORY CONTROL SYSTEM
Barry Lee Johnson (Ph.D. Thesis) 1967 210 p
Available from Univ. Microfilms: HC $9.45/MF $3.00 Order No. 67-12972

The purpose of this study was to study the regulatory effectiveness of the human respiratory control system. A mathematical model of the respiratory control system was developed assuming that the predominant factor in the regulation of minute ventilation is the carbon dioxide tension in the brain respiratory center. A set of two nonlinear differential equations was developed to describe the carbon dioxide regulator. The model was made applicable to both an adult and a neonatal control system. A stability analysis of the respiratory control system was effected using Lyapunov stability theory. It was found that the neonatal control system is inherently more stable than is the adult system. An analysis of the contribution that individual respiratory parameters have on respiratory stability revealed that the respiratory control system was driven in the direction of instability whenever the tissue level of carbon dioxide was decreased. Dissert. Abstr.

N68-30135# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.
MAN'S TOLERANCE TO TRACE CONTAMINANTS
A. A. Thomas Jan. 1968 45 p refs Presented at the Conf. on Bioastronautics, Blacksburg, Va., 14–18 Aug. 1967; Sponsored by NASA
(AMRL-TR-67-146; AD-669356)

Atmospheric contaminants in sealed cabins originate from a multitude of sources: off-gassing from cabin materials, production of contaminants by the life support system components, and the end products of human metabolism. The scope of the problem increases with progressing mission duration and can become the limiting factor for mans tolerance to extended space flight. Several important aspects must be considered: truly uninterrupted, continuous exposure, a combination of physiological stress from the use of artificial atmospheres and the chemical stress imposed by the trace contaminants, and the great potential of synergistic toxic effect by various constituents of the highly complex mixture of many contaminants. Superimposed on these factors are the other aggravating characteristics of prolonged space flight: logistics problems of life support and psychological effects of isolation on performance. Clearly, these factors must be weighed singly and in combination to allow safe design of future manned systems. Validation of human tolerance to trace contaminants can be accomplished by prolonged animal exposures coupled with mathematical model verification. Tradeoffs in life support system design can extend tolerance to contaminants and long range logistic tradeoffs should be considered by utilizing extraterrestrial resources for contaminant removal purposes. Author (TAB)

N68-30137# Aerojet-General Corp., Dayton, Ohio.
RESPONSES OF ANIMALS TO OXYGEN AT REDUCED PRESSURE
J. D. MacEwen, R. P. Geckler, and K. C. Back (AMRL) Wright-Patterson AFB, Ohio AMRL Feb. 1968 36 p refs
(Contract AF 33(657)-11305)
(AGC-3266; AMRL-TR-67-78; AD-669351)

As extensions of previous short-term experiments on the toxicity of oxygen at reduced pressure in animals, long-term continuous exposures of beagle dogs, rhesus monkeys and albino rats and mice were undertaken. The exposures were for 230 days to 100% oxygen at 5 psia. No mortality occurred in the exposed dogs or monkeys. More rats and mice died in the control groups than in the experimental groups, indicating no effects on mortality due to the experimental conditions. The growth rates of control and experimental rats were almost identical, further indicating lack of deleterious effects. Histopathologic examination of tissues was conducted on all four animal species. No differences were observed between exposed animals and their controls in monkeys, rats or mice. Minimal differences consisting of mild bronchitis and mild congestion were seen in the dogs exposed to 100% oxygen at reduced pressure. One exposed dog exhibited severe pulmonary changes associated with acute interstitial bronchial pneumonia. Periodic measurements of blood constituents showed no significant differences attributable to prolonged oxygen exposure at reduced pressure. Author (TAB)

N68-30218*# Scripta Technica, Inc., Washington, D. C.
THE EVIDENCE FOR THE TRANSFORMATION OF FEMALE FROGLETS INTO MALE ONES FOLLOWING UTERINE OVERMATURATION OF THE EGGS [DIE BEWEISE FUR DIE UMWANDLUNG WEIBLICHER JUNGFROSCHE IN MANNLICHE NACH UTERINER UBERREIFE DER EIER]
Emil Witschi Washington NASA Jul. 1968 15 p Transl. into ENGLISH from Arch. Fuer Mikroskopische Anatomie und Entwichklungsmechanik (USSR), v. 102, 1924 p 168–183
(Contract NASw-1694)
(NASA-TT-F-11757) CFSTI: HC $3.00/MF $0.65 CSCL 06C

The author shows that uterine overmaturity of eggs has a sex-transforming effect in frogs. Author

N68-30219*# Scripta Technica, Inc., Washington, D. C.
OVERMATURITY OF THE EGG AS TERATOGENETIC FACTOR [DIE UBERREIFE DES EIES ALS TERATOGENETISCHER FAKTOR]
E. Witschi Washington NASA Jul. 1968 3 p refs Transl. into ENGLISH from Zool. Anz. (Germany), 1925 p 91–94
(Contract NASw-1694)
(NASA-TT-F-11755) CFSTI: HC $3.00/MF $0.65 CSCL 06C

All manifestations due to overmaturity are due to chemical changes in the ageing egg. The author has investigated the attendant malformations in the three series of experiments. Author

N68-30260*# Techtran Corp., Glen Burnie, Md.
MODERN STATE AND PROSPECTS FOR THE SOLUTION OF THE PROBLEM OF THE ORIGIN OF LIFE [SOVREMENNOYE SOSTOYANIYE I PERSPEKTIVY RESHENIYA PROBLEMY VOZNIKNOVENIYA ZHIZNI]
A. I. Oparin Washington NASA Jul. 1968 17 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Biol. (Moscow), no. 5, 1967 p 656–667
(Contract NASw-1695)
(NASA-TT-F-11800) CFSTI: HC $3.00/MF $0.65 CSCL 06A

The appearance of life on earth was the final event of millions of years of prebiological evolution taking place under radiational and chemical conditions no longer existing on the planet. The initial stage of this evolution was the appearance of hydrocarbons, now known to arise spontaneously both on earth and elsewhere in the universe; from these were formed multimolecular compounds, and ultimately more extensive systems capable of

self-renewal. The structure and behavior of these early systems can be simulated by physico-chemical objects such as coacervate drops, which react with their environment as open systems, and which exhibit "protometabolic" activity based on the absorption of catalytic substances. Initial studies made with such models suggest that ultimately the synthesis of protoplasm may become possible with the use of similar techniques. Author

N68-30277# Federal Aviation Administration, Washington, D. C. Office of Aviation Medicine.
CIRCADIAN RHYTHMS AND THE EFFECTS OF LONG-DISTANCE FLIGHTS
Stanley R. Mohler, J. Robert Dille, and Harry L. Gibbons Apr. 1968 9 p refs
(FAA-AM-68-8)

Air travelers crossing four or more times zones experience significant desynchronization of certain daily biologic rhythms. Until rephasing of the rhythms occurs relative to the solar cycle at the destination, some subjective discomfort and disruption of psychophysiologic responses can occur. This paper reviews research on diurnal rhythms, discusses the implications for aircrew and passengers, and makes recommendations for reducing the effects of time zone displacements. Author

N68-30332# Harvard Univ., Cambridge, Mass.
PERCEIVING VISUAL TEXTURE: A LITERATURE SURVEY Final Report, Aug. 1964 – Aug. 1966
Ronald M. Pickett Wright-Patterson AFB, Ohio AMRL Mar. 1968 48 p refs
(Contract AF 33 (615)-1815)
(AMRL-TR-68-12; AD-670225)

The visual perception of texture is introduced as a research problem important, in itself, but important also as an entrance into the broader and little understood area of complex pattern perception. Definitions of texture, both from a substantive and an abstract standpoint, are presented and followed by discussions of: (1) the information carried in textures and (2) the possible functions of texture perception in visually controlled behavior. Then a review of laboratory and field studies is presented, followed by a discussion of directions for future research. A functional theory of pattern perception is assumed, in which the processing of substantive information in optical patterns is emphasized. The application of mans natural visual capacities is proposed for scientific imagery analysis. Techniques are suggested for presenting the imagery in an ecologically relevant context of substantive analysis and description. Author (TAB)

N68-30338*# Scripta Technica, Inc., Washington, D. C.
THE EFFECTS OF OVERMATURITY ON EGGS OF RANA TEMPORARIA [DIE EINWERKUNG DER UBERRISE AUF EIER VON RANA TEMPORARIA]
H. Eidmann Washington NASA Jul. 1968 11 p refs Transl. into ENGLISH from Biol. Zbl. (Leipzig), v. 42, no. 3, Mar. 1922 p 97–108
(Contract NASw-1694)
(NASA-TT-F-11782) CFSTI: HC $3.00/MF $0.65 CSCL 06C

The effect of overmaturity on eggs on the sex ratio of resulting Rana temporaria was discussed and it was shown that the cytoplasm is the only part affected. Author

N68-30361# General Technical Services, Inc., Upper Darby, Pa.
OSCILLATORY BEHAVIOR OF HEART RATE, VENTILATION AND SKIN TEMPERATURE IN RESTING HUMANS: TOWARDS A SPECTRAL ANALYZER Final Report, 1 May 1966 – 1 Aug. 1967
M. H. Halpern, E. D. Young, and M. H. Ehrenberg Wright-Patterson AFB, Ohio AMRL Jan. 1968 49 p refs
(Contract AF 33(615)-3917)
(AMRL-TR-67-228; AD-669361)

The physiological responses of human subjects were studied to determine the oscillatory frequencies of these responses. Heart rate, ventilation rate, and surface temperature were monitored from three subjects during quiescence and light exercise under conditions of fasting and immediately after food intake. A pattern of rhythmical oscillations was found for each of the three physiological parameters which varied with the specific experimental conditions. The method of handling the data and extracting the oscillations from the raw data is discussed in detail. The mathematical basis of this method is presented. Possible other applications of these techniques to data handling, compression, and reduction are also examined. Author (TAB)

N68-30376# Michigan Univ., Ann Arbor. Mental Health Research Inst.
THE MAMMALIAN CENTRAL NERVOUS SYSTEM AS A NETWORK Final Report, Jul. 1965 – Aug. 1967
Anatol Rappoport, William J. Horvath, R. Baldwin Small, and Stephen S. Fox Wright-Patterson AFB, Ohio AMRL Apr. 1968 673 p refs
(Contract AF 33(615)-2956)
(AMRL-TR-67-187; AD-670193)

The central nervous system of mammals is described in terms of block diagrams and a 418 x 418 matrix showing the connections between identifiable sites. The terminology is neuroanatomical and the sites are the identifiable cell groupings (nuclei and other structures) in the brain and spinal cord. The connections between these sites were obtained from the published literature on the anatomy of the nervous system. The use of systems notation to describe this rich network of connections leads to a readily available data bank for carrying out various types of mathematical and theoretical studies, as well as a convenient reference and guide for future neurophysiological and anatomical research. Author (TAB)

N68-30399*# Scripta Technica, Inc., Washington, D. C.
EXPERIMENTS ON THE FERTILIZATION OF OVERMATURE EGGS [VERSUCHE DER BEFRUCHTUNG UBERREIFER EIER]
E. Pflueger Washington NASA Jul. 1968 2 p Transl. into ENGLISH from Arch. Ges. Physiol. (Berlin), 1882 p 76–77
(Contract NASw-1694)
(NASA-TT-F-11783) CFSTI: HC $3.00/MF $0.65 CSCL 06C

The results of several series of experiments on fertilization of overmature eggs in frogs are presented. Author

N68-30400*# Scripta Technica, Inc., Washington, D. C.
RESPIRATORY QUOTIENT AND OXYGEN UPTAKE [V. RESPIRATORISCHER QUOTIENT UND O_2—AUFNAHME]
E. Hohwu Christensen and Ove Hansen NASA Jul. 1968 9 p refs Transl. into ENGLISH from Scand. Arch. Physiol., v. 81, 1939 p 180–189
(Contract NASw-1694)
(NASA-TT-F-11809) CFSTI: HC $3.00/MF $0.65 CSCL 06P

At low exertion levels, blood lactate levels remain the same as at rest. At high (but not maximum) exertion both blood lactate concentrations and lactate metabolism increase. At maximum exertion muscle processes become anaerobic and lactate accumulates. The importance of the liver in the regulation of the respiratory quotient is discussed. Author

N68-30448*# Scripta Technica, Inc., Washington, D. C.
BIO-CYCLERGOLOGY AND ASTRONAUTICS [BIO-CYCLEROGLOGIE ET ASTRONAUTIQUE]

G. Cantoni and J. Borsarello NASA Jul. 1968 10 p ref Transl. into ENGLISH from Rev. Franc. D'Astronautique (Paris), Dec. 1967 p 21–27
(Contract NASw-1694)
(NASA-TT-F-11828) CFSTI: HC$3.00/MF$0.65 CSCL 06S

Under the neologism bio-cyclergology the circulation of energy in the system, which cyclic energy may be regulated or re-balanced by acupuncture is considered. This examination leads to an estimation of the consequences which a sudden and prolonged change of magnetic, gravitational or ionic environment may have upon the system, for example, of a cosmonaut. The conclusion is reached, however, that man's prodigious faculty of adaptation will carry him through these stages of progress. Author

N68-30453# Michigan Univ., Ann Arbor.
SOME MATHEMATICAL MODELS IN BIOLOGY
Robert M. Thrall, ed., James A. Mortimer, ed., Kenneth R. Rebman, ed., and Richard F. Baum, ed. Dec. 1967 524 p refs Revised Sponsored by NIH
(Rept.-40241-R-7)

A collection of examples illustrating mathematical applications to biological subjects is presented with the purpose of (1) delineating areas of mathematics that are applicable to modern biology, (2) to provide a source of biomathematical examples for authors of mathematical and biological textbooks, and (3) to be used as a supplement in lectures and course work in cases where standard texts are deficient. The models include a wide spectrum of mathematics, from foundations and elementary calculus to more advanced topics in linear algebra, probability, and differential equations. The models are grouped into four major sections corresponding to the four principal areas of molecular biology, the biology of cells and tissues, the biology of organs and organisms, and population biology. B.S.D.

N68-30458# Army Natick Labs., Mass. Technical Library.
LABORATORY ANIMALS: THEIR CARE AND USE IN RESEARCH
Eugene G. Beary Jan. 1968 58 p refs *Its* Bibliog. Ser. 68-1
(AD-669617)

The checklist bibliography contains 484 references to the literature on the care and handling of laboratory animals and their use in research. The time coverage is 1950 to May 1967. The citations are arranged alphabetically by personal author. Subject and author indexes are included. Author (TAB)

N68-30527*# Research Triangle Inst., Durham, N. C. Engineering and Environmental Sciences Div.
BIOMEDICAL APPLICATIONS OF NASA SCIENCE AND TECHNOLOGY Final Report, 15 Jun. 1967–14 Jul. 1968
Jul. 1968 70 p refs
(Contract NSR-34-004-045)
(NASA-CR-95804; RTI-EU-349) CFSTI: HC $3.00/MF $0.65 CSCL 06B

Updated data are presented on the various activities conducted by the biomedical applications team. The primary objectives of the applications teams are: (1) to identify problems and needs existing in the medical field which appear to be solvable by the application of aerospace science and technology, (2) to identify the specific technologies or concepts which may lead to solutions of these problems, and (3) to document these transfers of science and technology so as to achieve maximum utilization of the results of the program. The problem and the solution for each transfer are detailed, the searching method and source of solution are identified, the actual or potential benefits resulting from the transfer are discussed, and the status of the transfer is given. Twelve potential transfers of technology which are in various stages of evaluation are assessed. Attention is also directed to problems which are still under consideration and to which solutions are still being sought on some regular review basis or on a continuing investigative basis. B.S.D.

N68-30528# Notre Dame Univ., Ind. Lobund Lab.
BIBLIOGRAPHY OF GERMFREE RESEARCH: 1885–1963, 1966 SUPPLEMENT
B. A. Teah 1967 24 p refs
(Contract Nonr-1623(15))
(AD-669964)

The bibliography lists 335 report titles, presented in author-index form, and representing medical research studies performed in connection with germ-free animals. TAB

N68-30530*# Techtran Corp., Glen Burnie, Md.
FURTHER INVESTIGATIONS ON THE SEXUALITY PROBLEM [WEITERE UNTERSUCHUNGEN UBER DAS SEXUALITATSPROBLEM]
R. Hertwig Washington NASA Jun. 1968 32 p Transl. into ENGLISH from Trans. of the Ger. Zool. Soc. 16th Ann. Meeting, Marburg, Ger., 5–7 Jun. 1906, Leipzig, Wilhelm Engelmann Press, 1906 p 90–112
(Contract NASW-1695)
(NASA-TT-F-11780) CFSTI: HC$3.00/MF$0.65 CSCL 06C

The sexuality problem, as it relates to protozoa, Dinophilus apatris, daphnids, and *Rana temporaria*, is discussed from the standpoint of the development of the genital organs of these organisms, by which their sex is identified. The effect of the nuclear-plasmic relationship is also considered, and a mathematical expression is developed for the effect of this relationship on sexual development. Author

N68-30555*# Institute of Modern Languages, Inc., Washington, D. C.
MECHANISM OF INCREASING OSMOTIC RESISTANCE OF ERYTHROCYTES IN RATS ADAPTED TO HYPOXIA [K VOPROSU O MEKHANIZME POVYSHENIYA OSMOTICHESKOY REZISTENTNOSTI ERITROTSITOV ADAPTIROVANNYKH K GIPOSKII KRYS]
Z. I. Barbashova NASA Jun. 1968 10 p refs Transl. into ENGLISH from Fiziol. Zh. SSSR (Moscow), v. 50, no. 11, 1964 p 1385–1392
(Contract NASW-1693)
(NASA-TT-F-11410) CFSTI: HC$3.00 CSCL 06C

On the basis of experimental data, it is determined that the increase in the osmotic resistance of rats adapted to hypoxia is an adaptive reaction which forms a part of the general mechanism of increasing the resistance of the organism. Author

N68-30585# Southampton Univ. (England). Audiology and Human Factors Group.
PHYSIOLOGICAL FACTORS INVOLVED IN THE EVALUATION OF THE LOUDNESS OF SHORT DURATION SOUNDS
A. R. D. Thornton [1968] 18 p refs
CFSTI: HC$3.00/MF$0.65

Before the loudness and possible damaging effects of sounds can be calculated, the various physiological mechanisms of the ear, which effect any subjective evaluation, must be taken into account. The physiological mechanisms of integration of energy and post-stimulatory masking are discussed. Recent work has shown that these are not independent phenomena. When a sound is in a post-stimulatory masked state an inhibitory physiological feedback acts to conteract the normal integration of energy contained in a short duration sound. The implication of this is that the total energy in such a sound will not contribute to the overall loudness, and hence calculations of loudness, based on energy integration methods, may have to be modified. Author

N68-30634# Kansas State Univ., Manhattan. Dept. of Psychology.
PROBLEMS IN THE SPECIFICATION OF LUMINOUS EFFICIENCY: STUDY OF VISUAL PERCEPTION IN HUMANS AND ANIMALS Technical Report, Apr.–May 1968
John Lott Brown May 1968 27 p refs
(Contract Nonr-3634(04))
(TR-5; AD-670053)

Problems of specifying luminous efficiency are considered in relation to the entire range of visual function from scotopic to photopic. The changing spectral response which accompanies changing adaptation and changing nature of the visual task is taken into account. Author (TAB)

N68-30741# Army Medical Research Lab., Fort Knox, Ky.
PULFRICH EFFECT WITH MINIMAL DIFFERENTIAL ADAPTATION OF THE EYES Interim Report
P. C. Dodwell (Queens Univ., Kingston, Ontario), George S. Harker, and Isaac Behar 5 Apr. 1968 23 p refs
(USAMRL-773; AD-670011)

Both experienced and naive Ss measured the displacement of a Pulfrich target with a sensitive stereoptometer when only the image of the moving target was filtered. The usual monotonic function of filter density was observed; the calculated retinal latency differences were consistent with those in the literature. Asymmetries in the Pulfrich effect with respect to direction of motion and individual differences were noted. It is suggested that two processes are confounded in the usual Pulfrich situation--contrast of the Pulfrich target and retinal adaptation. Author (TAB)

N68-30765*# Techtran Corp., Glen Burnie, Md.
ON THE PROBLEM OF SEX DIFFERENTIATION [UBER DAS PROBLEM DER SEXUELLEN DIFFERENZIERUNG]
R. Hertwig Washington NASA Jun. 1968 20 p Transl. into ENGLISH from the Trans. of the Ger. Zool. Soc. 15th Ann. Meeting, Breslau, Ger., 13–16 Jun. 1905
(Contract NASw-1695)
(NASA-TT-F-11779) CFSTI: HC$3.00/MF$0.65 CSCL 06C

The problems of sexual differentiation of daphnids, *Dinophilus apatris*, frogs, *Rana temporaria*, and *Rana esculenta* are experimentally investigated. The important points from two earlier works on protozoa are summarized by way of introduction. The various aspects of cell function affecting sexual differentiation, such as nuclear-plasmic relationships, cell division, assimilatory activity, etc. and environmental factors, such as feeding, temperature and egg size, are considered. It was found, for example, that warmth favors the development of male eggs of *Dinophilus apatris*. Author

N68-30832*# Techtran Corp., Glen Burnie, Md.
FURTHER INVESTIGATIONS ON THE SEXUALITY PROBLEM [WEITERE UNTERSUCHUNGEN UEBER DER SEXUALITATSPROBLEM]
R. Hertwig Washington NASA Jun. 1968 28 p Transl. into ENGLISH from the book "Verhandlungen der Deutschen Zoologischen Gesellschaft Auf der Seibzehnten Jahresversammlung zu Rostock und Lubeck, den 21 Bis 23 Mai 1907" Leipzig, Wilhelm Engelmann Press, 1907 p 55–73
(Contract NASw-1695)
(NASA-TT-F-11781) CFSTI: HC$3.00/MF$0.65 CSCL 06C

Sex determining factors affecting the sexual development of the eggs of *Rana esculenta*, *Rana temporaria*, and frogs are experimentally investigated. The question of whether the sperm of *Rana esculenta* affects the sexual development of the egg is the chief subject of this report. Results of the studies indicate that the sperm indeed does exercise a significant influence on sexual determination. Author

N68-30833*# Scripta Technica, Inc., Washington, D. C.
EXPERIMENTAL INVESTIGATION OF SEX TRANSFORMATION IN THE FROG [EXPERIMENTELLE UNTERSUCHUNGEN UEBER DIE UMWANDLUNG DES GESCHLECHTS GEIM FROSCH]
K. Wagner NASA Jul. 1968 9 p refs Transl. into ENGLISH from Arch. Entwicklungsmech. Organ. (Berlin), v. 52–97, 1923 p 386–394
(Contract NASw-1694)
(NASA-TT-F-11784) CFSTI: HC$3.00/MF$0.65 CSCL 06C

Presented are results of studies on late fertilization of eggs of *Rana fusca* and its effects on the sex ratio. Author

05 BIOTECHNOLOGY

Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N68-29593# Naval Air Development Center, Johnsville, Pa. Aerospace Crew Equipment Dept.
COMPARATIVE STUDY OF BODY DISPLACEMENTS IN BOTH HUMANS AND ANTHROPOMORPHIC DUMMIES WHEN SIMULTANEOUSLY SUBJECTED TO CONTROLLED VERTICAL IMPACT TYPE DECELERATIONS Interim Report
Marcus Schwartz 8 Apr. 1968 185 p *Its* Found. Res. Proj. No. 15
(NADC-AC-6808; AD-669466)

The report concerns Phase I of a research program to determine if a correlation in displacements exists between humans and anthropomorphic dummies of like proportions when subjected to vertical crash type forces for extrapolation into the high impact region where only dummies can be utilized. Although similarities were found when comparing the displacements in the leg area, the upper torso could not be correlated in any but a highly complex way. Although direct correlation is not practical, much useful information has been gained. The dynamics of the human body as it affects the performance of pilot ejection systems is considered to be very significant, and as yet undetermined. Author (TAB)

N68-29601*# Michigan Univ., Ann Arbor. Center for Research on Utilization of Scientific Knowledge.
ORGANIZATIONAL BEHAVIOR RESEARCH UTILIZATION PROCESSES. A STUDY OF PROCESSES FOR THE UTILIZATION OF SCIENTIFIC FINDINGS FROM ORGANIZATIONAL BEHAVIOR RESEARCH Final Report
27 Oct. 1967 196 p
(Grant NGR-23-005-116)
(NASA-CR-89837) CFSTI: HC$3.00/MF$0.65 CSCL 05J

Seminars, individual questionaires, evaluation sheets, and assessment sheets are employed as techniques for utilization of organizational behavior research knowledge by a specific complex organization element. The organizational research material selected for use pertained to promotion of new patterns of management and motivational approach to supervision, personnel performance and productivity, and most effective practices of supervision and management of professional and scientific personnel. Problems of supervision and management in the specified organization element are identified, described, and assessed. Feasibility of applying research knowledge to such problems is determined. Alternative methods which could be used to transfer and apply research knowledge to management problems are developed and evaluated. Summary conclusions offered are that the seminar approach is an effective method of transferring behavioral science research knowledge to managers, and that the several utilization techniques must be viewed in terms of characteristics of the using organization and its leadership. D.H.S.

N68-29694# American Inst. for Research, Pittsburgh, Pa. Team Training Lab.
INCREASING TEAM PROFICIENCY THROUGH TRAINING Final Summary Report No. 8, Dec. 1960–Aug. 1967
David J. Klaus and Robert Glaser May 1968 65 p refs
(Contract Nonr-2551(00))
(AIR-E1-6/68-FR; AD-669688)

The report summarizes the results of research at the Team Training Laboratory from December 1960 until August 1967. During this time seven technical reports were issued by the laboratory. This summary report briefly describes each of these seven studies and reviews their purpose and major results. The final section of this report identifies some practical implications of this research and relates the underlying concepts to the broader context of social behavior. Author (TAB)

N68-29695# American Inst. for Research, Pittsburgh, Pa. Team Training Lab.
INCREASING TEAM PROFICIENCY THROUGH TRAINING 7: THE SIMULATION OF TEAM ENVIRONMENTS
Jerry G. Short, Timothy Cotton, and David J. Klaus May 1968 65 p refs
(Contract Nonr-2551(00))
(AIR-E1-5/68-TR; AD-669687)

Three studies of simulated team environments are described in the report. Each study dealt in some way with the transition performance decrement that occurs when individuals are placed in teams. Study 1 found that this decrement was, in a large part, a function of the change in reinforcement ratio that occurred between individual and team training. Study 2 showed that reinforcement in the team environment was a function of characteristics of the team members themselves--their number and the proficiencies. An increase in the number of team members or a decrease in their proficiency produced lower reinforcement ratios and these in turn produced larger decrements in performance and increased the time required for teams to reach high levels of proficiency. Study 3 showed that the transition performance decrement could be reduced by certain training strategies notably those involving a simulation of the team environment during individual training. Author (TAB)

N68-29720# School of Aerospace Medicine, Brooks AFB, Tex.
ENDOCRINE-METABOLIC EFFECTS OF UNUSUALLY LONG OR FREQUENT FLYING MISSIONS IN C-130E OR C-135B AIRCRAFT Final Report, Nov. 1964–Dec. 1967
Henry B. Hale, Clarence A. Anderson, Edgar W. Williams, and Emanuel Tanne Mar. 1968 23 p refs
(SAM-TR-68-24; AD-669346)

Flight-stress appraisal was made by means of a battery of urinary determinations (epinephrine, norepinephrine, 17-OHCS, urea, uric acid, phosphorus, magnesium, sodium, and potassium) for flyers who participated in (a) 20-hour missions in C-130E aircraft (flights from New Zealand to Antarctica, and back), (b) 6-day missions in C-135B aircraft (earth-circling missions), or (c) 7-week missions in C-135B aircraft (over-frequent transoceanic and transcontinental flying). The adrenal medulla (as judged by urinary epinephrine) consistently showed flight-sensitivity, but other endocrine-metabolic functions varied in ways indicative of adaptation. With flight circumstances standardized (particularly with respect to time of day), flight effects tended to be reproducible. With crew rest limited to 2 days, recovery from flight-stress tended to be incomplete. Sleep deprivation and crew position were shown to be factors which modify flight-stress reactions. Eastbound and westbound earth-circling missions did not induce different degrees of flight-stress, as judged by these endocrine-metabolic indices. Author (TAB)

N68-29838# Allied Chemical Corp., Morristown, N. J. Industrial Chemicals Div.
EXPERIMENT OF DAMAGE CONTROL MATERIALS AND METHODS FOR FLEET HANDLING OF PACKAGED LIQUID PROPELLANTS Quarterly Report, 1 Jan.–31 Mar. 1968
R. J. Foley 31 Mar. 1968 10 p
(Contract N00019-67-C-0538)
(QR-3; AD-669437)

An investigation is being conducted to evaluate the compatibility of certain damage control materials and equipment with chlorine trifluoride (CTF), a liquid propellant. The trace gas analyzer previously tested and approved for CTF service was calibrated for MHF-3 in the range of 0 to 20 ppm. The analyzer was calibrated under stable and shipboard-like conditions and produced protective responses. The prototype protective suit made of the neoprene-coated nylon cloth was received from the manufacturer, but was rejected because it did not comply with our specifications. Exposure tests were conducted on the skin of live rabbits with low concentrations of CTF. It was found that a 30 minute exposure of CTF even as dilute as 0.1% had an adverse effect on this skin. TAB

N68-29984* TRW Systems, Redondo Beach, Calif.
THERMAL PROPERTY MEASUREMENTS OF MANNED SPACECRAFT CENTER SPACESUIT MATERIALS Measurements Reports
F. J. Turnbow May 1968 4 p ref
(Contract NAS9-3670)
(NASA-CR-92198; TRW-68-3346.11ja-38) CFSTI: $3.00 CSCL 06Q

Near-normal emittance properties of a face shield and a test chip were determined from reflectance data measured with an infrared reflectometer. Results are tabulated for the measurements taken at 13 positions on the external surface of the shield, and at 3 test chip positions. Author

N68-29985# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PSYCHOPHYSIOLOGICAL FEATURES OF FLIGHT OVER WATER [PSIKHOFIZIOLOGICHESKIYE OSOBENNOSTI POLETA NAD MOREM]
I. D. Dolinskiy 22 Sep. 1967 13 p refs Transl. into ENGLISH from Morskoi Sb. (Moscow), no. 8, 1965 p 44–50
(FTD-MT-24-124-67; AD-669269)

The difficulties associated with long flights over the sea stem from the lack of visual orientation and from the extreme meteorological conditions encountered. Since the interaction of physiological and psychological factors, not yet fully understood, may result in illusions, flight must be conducted by instruments. Instrument flying requires experience before pilots gain confidence in the instrument indications and accept them in lieu of erroneous sensations. Trained pilots can scan the instruments, correlate the readings to detect malfunctions, and analyze data. Standardization of the instrument panel facilitates training, and automation of the instrumentation simplifies the technique. In one automation system the images of the instruments are projected on the front cabin window, enabling the pilot to maintain visual contact with his environment while surveying the instruments. It has been noted that certain physical activities during flight reduce the illusion effect and that physically fit crews are less susceptible to illusions. For this reason a well planned and executed program of athletics and sports would be instituted for all air crews. The added danger of flying over water gives rise to fears which can aggravate the illusion effect. This fear can best be overcome by intensive rescue training, which gives the crews confidence in their own survival ability, in the rescue equipment, and in the search and rescue procedure. Since crews are scattered over wide areas when bailing out of fast, high flying planes, the rescue training must emphasize the individuals battle with the elements. Author (TAB)

N68-30107# General American Transportation Corp., Niles, Ill. General American Research Div.

AUTOMATIC WATER RECOVERY SYSTEM Final Report, Oct. 1964–Dec. 1966

Phillip P. Nuccio and Walter J. Jasionowski Wright-Patterson AFB, Ohio AMRL Mar. 1968 36 p

(Contract AF 33(615)-2124)

(GARD-1271; AMRL-TR-67-155; AD-670178)

A water recovery system for reclaiming potable water from urine and other waste waters was designed, fabricated and tested. The system operates on the vacuum distillation principle with vapor compression for the recovery of latent heat. Chemical pretreatment of the waste liquid is employed and the condensate is post-treated by absorption and filtration. A unique waste-liquid recycle technique was developed. The technique maintains clean evaporator surfaces (thus eliminating the need for periodic cleaning), and permits continuous automatic operation for an indefinite period. The system is designated GARD Model 1271 Automatic Water Recovery System. The materials, finishes, and built-in artificial gravity required for a flight qualifiable system were incorporated into the model which weighs 98 pounds and occupies less than 2.5 cubic feet. Electrical energy consumption varied according to the solids concentration of the feed liquid, and ranged from 34.6 watt-hours per pound of potable water recovered from low-solids urine to 55.4 watt-hours per pound when processing urine concentrated to 32 percent solids. During a 14-day acceptance test performed on the model, 421 pounds of potable water were recovered from 490 pounds of urine for a yield efficiency of 86 percent. Author (TAB)

N68-30118# HRB-Singer, Inc., State College, Pa.

THE DEVELOPMENT OF A DIGITAL HELIUM SPEECH PROCESSOR Final Report, May 1967–May 1968

J. B. Wible May 1968 59 p

(Contract N00014-66-C-0228)

(HRB-4007-F-2; AD-669469)

The report describes a development program for a small laboratory processor of speech generated in a hyperbaric helium environment. Prior research shows that distortion associated with this helium speech arises from upward shifted format frequencies and a decreasing consonant-vowel ratio. These two factors form the basis for the design of the processor which operates in real time using digital techniques. Test and evaluation of the portable processor and associated microphones followed the developmental phase. Improved intelligibility of helium speech was observed with the use of the processor under various combinations of speaker, microphone, and hyperbaric helium atmosphere. Author (TAB)

N68-30144# Joint Publications Research Service, Washington, D. C.

PROBLEMS IN CREATION OF CLOSED ECOLOGICAL SYSTEMS

2 Jul. 1968 255 p refs Transl. into ENGLISH of the book "Problemy Sozdaniya Zamknutykh Ekologicheskikh Sistem" Moscow, 1967 p 1–259

(JPRS-45837) CFSTI: HC$3.00/MF$0.65

In the articles presented, consideration is given to the possibilities of using closed ecological systems in mastering extraterrestrial space and as models for studying biological phenomena. Attention is focused on the biological and physicochemical aspects of the regeneration of air and water, and on the utilization of excreta in closed systems. Patterns in the development of populations and cenospecies in the natural and artificial ambiance are discussed in relation to the problem of creating such closed ecological systems. Author

N68-30150*# Life Sciences Research Inst., Inc., Richmond, Va.

VALIDATION OF NEW INDEXES OF MEASUREMENT: RELATIONSHIP OF RATE OF CHANGE PARAMETERS TO TASK PERFORMANCE UNDER STRESS

Robert G. Gibby, Sr. and Robert G. Gibby, Jr. 4 May 1968 104 p refs

(Contract NAS9-7142)

(NASA-CR-92203) CFSTI: HC$3.00/MF$0.65 CSCL 06P

Rate of change (RC) and rate of rate of change (RRC) of heart rate was related to proficiency in performing perceptual, psychomotor, and cognitive tasks of various levels of complexity; and both psychological and physiological stresses were applied to college students majoring in science or engineering who were at least 19 years of age. Data were collected for 80 students for whom a Pearson product-moment correlation of .97 was obtained for RC stress and RRC stress, .96 for RC nonstress and RRC nonstress, 66 for RC nonstress and RC stress, and .62 for RRC nonstress and RRC stress. Students considered labile on either RC or RRC basis did not perform as well under stress on the perceptual and cognitive tasks as did subjects considered stabile, but there was no significant difference in motor task performance for the two groups. M.W.R.

N68-30186# European Atomic Energy Community, Ispra (Italy). Scientific Information Processing Center.

MACACO—PREST: AN ANALOG MODEL AND A DIGITAL CODE FOR CONTAINMENT STUDIES

G. Gaggero, P. M. Gerini (Centro Informazioni Studi Esperienze), G. Leoni (Centro Informazioni Studi Esperienze), and J. B. van Erp Brussels May 1968 144 p refs Prepared jointly with Centro Informazioni Studi Esperienze, Milan

(EUR-3927.E) CFSTI: HC$3.00/MF$0.65

A mathematical model is presented for the determination of pressure and temperature transients inside the containment building, following a loss of coolant accident due to a rupture in the primary cooling system of a nuclear power plant having water as the primary coolant. The model includes the calculation of the radiation doses incurred to the thyroid due to inhalation of radioactive iodine released outside the containment building as a function of height of release, time of exposure, distance, etc. The model in its present form is limited as regards its application to dry containment systems without pressure relief (pressure-suppression systems are, e.g., not covered). The mathematical model was first used in conjunction with an analog computer and was subsequently programmed and extended for digital computer use (code: PREST), for more rapid availability as a computation tool for routine evaluations. Author

N68-30189*# National Aeronautics and Space Administration, Washington, D. C.

NEW TECHNIQUES IN INVESTIGATING HANDLING QUALITIES

H. Frohlich, W. Kreil, Schweizer, and K. Stopfkuchen Jul. 1968 35 p refs Transl. into ENGLISH from Aerospace Proc. 1966, Roy. Aeron. Soc., Centenary Congr. and Intern. Council of the Aeron. Sci., 5th Congr., London, V. 2, 12–16 Sep. 1966 p 931–962

(NASA-TT-F-11844) CFSTI: $3.00 CSCL 05H

The design of the controls of a manned aircraft in the development stage requires knowledge of the dynamic behavior of the pilot-aircraft system with the utmost accuracy possible. While with presently available means it is in general easy to simulate the behavior of an aircraft in a model, the representation by models of the dynamic behavior of man is fraught with considerable difficulties. The model of a pilot generally used heretofore does not always lead to satisfactory results. A new model is thus proposed for discussion; it differs from the conventional concept by the fact that its parameters are not assumed to be constant, but that they are stochastically variable. It is assumed that the stochastic variations of the parameters are stationary. The model proposed can be used both in simulation and in free flight for measurement purposes. Control experiments were performed with the aid of the pilot model both on a VTOL transport and various helicopters. Results are presented for simulated and for free flights. Author

N68-30294# Aeronautical Research Labs., Melbourne (Australia).
THE TWO-DIMENSIONAL TRACKING TASK FOR USE IN COMPARATIVE EVALUATION OF INSTRUMENT DISPLAYS
T. J. Triggs Aug. 1966 11 p
(ARL/HE-20) CFSTI: HC $3.00/MF $0.65

Experiments to evaluate visual information displays frequently yield no significant differences between the various presentations considered. In order to minimize the possibility of the type 2 errors (i.e., failing to show statistically significant differences when in fact real differences exist), this project developed a rationale for improving experimental sensitivity by use of an extra loading task. Experiments in the past have used the display reading alone or reading in a highly redundant system operation. The use of the extra task procedure received some justification from the results of this experimental program. Two dimensional compensatory visual tracking with a random-appearing but coherent signal input was used as the extra task. Described here is the equipment designed for this tracking task, the generation of signals, display, and scoring of performance. Also included are some details of equipment used with the altimeter displays. A novel technique was developed for scoring the tracking task. Author

N68-30457# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVARIANCE DURING IDENTIFICATION BY COMPARING A DESCRIPTION WITH A SAMPLE [INVARIANTNOST' PRI OPOZNANII SRAVNENIYEM OPISANIYA S OBRAZTSOM]
V. A. Makhonin 30 Aug. 1967 12 p refs Transl. into ENGLISH of "Teoriya Peredachi Informatsii" Moscow, 1965 p 11-15
(FTD-MT-24-192-67; AD-670296)

The modern approach to recognition utilizes an indirect recognition by means of characteristics rather than by direct superposition comparison with the standard pattern. The recognizing characteristics are description functionals which are invariant regarding the permissible transformation of the object. The present author discusses all the elements needed for the establishment of the invariant recognition: the definition of a pattern, the methods for the transformation of such a pattern making the pattern suitable for the description, and the method for the comparison between the description and the reduced pattern. This is followed by a study of some of the possible criteria for the similarity between the description and the pattern. The article concludes with a discussion of the joint properties of the invariant recognition approach and visual perception. Author (TAB)

N68-30589# Aeronautical Research Council (Gt. Brit.).
THE EFFECTS OF EXTENDED PRACTICE ON PERFORMANCE IN A TRACKING TASK
R. C. Hornby (Queens Univ., Belfast) and R. Wilson (Queens Univ., Belfast) Dec. 1967 23 p
(ARC-29887; AD-670303)

Experimental measurements of human controller performance have been made during extended periods of practice in visual sine-wave tracking tasks. It has been found that, irrespective of task difficulty, RMS error scores decreased to such small magnitudes that differences in scores due to different task variables would have no practical significance. Thus the averaged values of steady scores when tasks are well learnt are meaningless for subject or task difficulty comparisons. It has been shown that the performance scores vary in an exponential manner with the number of task repetitions and it is proposed that an empirical constant related to the rate of decrease of scores be used as a measure of relative task difficulty. Author (TAB)

N68-30602*# Bolt, Beranek, and Newman, Inc., Van Nuys, Calif.
THE NOISINESS OF TONES PLUS NOISE
Karl S. Pearsons, Richard D. Horonjeff, and Dwight E. Bishop Washington NASA Aug. 1968 89 p refs
(Contract NAS1-6364)
(NASA-CR-1117; Rept.-1520) CFSTI: HC $3.00/MF $0.65 CSCL 06P

A series of judgment tests were conducted to investigate subjective judgments of single, modulated and multiple tones plus noise. The subjects were asked to judge which of two sounds, tones plus noise or noise alone, was noisier (or in some cases louder). Stimuli included both broadband and octave band noises together with single tones at 250, 500, 1000, 2000, and 4000 Hz. Amplitude and frequency modulated tones of 500 and 2000 Hz were also employed. Multiple tone stimuli included 2 and 5 tone complexes with overall frequency spacings of 1/10, 1/3, 1, 4/3 and 2 octaves. Analysis of the judgment results were made using calculated perceived noise level and pure tone correction procedures. Author

N68-30611# Edinburgh Univ. (Scotland). Bionics Research Lab.
VISUAL PERCEPTION IN SIMULATED SPACE CONDITIONS
James A. M. Howe and Richard L. Gregory 4 Jun. 1968 26 p refs
(Grant AF-AFOSR-65-62)
(AFOSR-68-1212; AD-670166)

The stimulus to the research reported was the finding that in complete darkness - the conditions of Space - afterimages can change systematically when their apparent distance alters due to movement of the observer. If the apparent size changes of the afterimage during movement of the observer could be measured, the constancy scaling process could be quantified. Since afterimages cannot be physically controlled, a new method was devised. The logic of the method is that the observer views a luminous object whose size may be varied in a controlled manner related to his movement. The display is made to shrink in size as he approaches it, the rate of shrinkage being adjusted until it is reported as appearing unchanging. A verbal report of an amount of expansion or contraction is unsatisfactory since it cannot reliably be quantified, but an observer can without difficulty state whether or not he can detect a change. This is a null technique which uses the observer as a detector rather than as a calibrated instrument. Author (TAB)

N68-30638# Bureau of Social Science Research, Inc., Washington, D. C.
AEROSPACE POWER AND BEHAVIORAL KNOWLEDGE Final Scientific Report
Albert D. Biderman 29 Mar. 1968 18 p
(Contract AF 49(638)-1344)
(AFOSR-68-0631; AD-669837)

A variety of approaches were used to examine ways in which the social and behavioral sciences may be of use to policy, plans and operations of the Air Force. These approaches included documentary analyses, participant observation, interviews of research users and producers, and observations of use in a training program. Special attention was given to the utilization of social science research for dealing with international affairs, the problems of personnel in hostile custody, the selection and assessment of officers for responsible and sensitive roles, and the education of officers. Author (TAB)

N68-30686# Sanders Nuclear Corp., Nashua, N. H.
FEASIBILITY STUDY AND CONCEPTUAL DESIGN FOR A PERSONAL THERMAL CONDITIONING SYSTEM
John J. Sullivan, N. R. Disco, and A. Wong Dec. 1967 327 p refs
(Contract F41609-67-C-0096)
(AMD-TR-68-1; AD-670212)

An airman forced to eject over Arctic terrain or cold water is faced with a very brief survival period after landing. (Approximately three minutes in 28F water.) This period of time is insufficient to initiate and accomplish a successful rescue mission. A study has been made to determine the feasibility of extending the survival period by warming the airman with heat generated by a radioisotope. A conceptual design has been created consisting of a network of water filled tubes worn beneath an insulated suit. Water in the tubes is heated by a 500 watt radioisotope to warm the pilot during a survival situation (28F water or -65F air), and is cooled by an 825 watt refrigerator to keep the airman comfortable while flying the aircraft with cabin temperatures up to 120F. A thermo-electric power generator supplies 12 watts of power for the water pump. Comparison studies of several radioisotopes have been made. System calculations and component calculations show that the concept is feasible and practicable for extending the survival period indefinitely. The survival system weight is estimated at 80 pounds and is configured to fit in a USAF standard ejection seat kit. Author (TAB)

N68-30708# Tracor, Inc., Austin, Tex.
TOWARDS THE LOGICAL AND METAPHYSICAL FOUNDATIONS OF ORGANISMIC THEORY: A PREREQUISITE TO ARTIFICIAL INTELLIGENCE
Norman F. Hirst and Caroline Perkins Hirst Feb. 1968 36 p refs
(Contract DAAB07-67-C-0559)
(TRACOR-68-252-U; AD-669738)

To build machines which are going to function intelligently we have first to understand the nature of an organism and the nature of value. These two notions have not yet been developed well enough; implicit metaphysical presuppositions at the core of much of our thinking have stood in our way. These presuppositions have been made explicit and have been challenged and replaced in Whiteheads general cosmology. Unfortunately, Whiteheads theory awaits formalization. Its implications cannot be brought out systematically until it is formalized. The usual logical systems, such as the propositional and predicate calculi, are not suited to the formalization of Whiteheads metaphysics; they carry with them metaphysical assumptions which are contrary to his thinking. To produce a formalization of Whiteheads theory we propose to use combinatory logic, which is somewhat more neutral, and in particular theory of functionality. Author (TAB)

N68-30715# Naval School of Aviation Medicine, Pensacola, Fla.
STABILITY OF EDWARDS PERSONAL PREFERENCE SCHEDULE NEED SCALE SCORES AND PROFILES OVER A SEVEN-WEEK INTERVAL
Lawrence K. Waters 18 Oct. 1967 10 p refs
(NAMI-1019; AD-669798)

Seven-week test-retest correlations were obtained for need scale scores and individual need profiles for a sample of pre-flight students. The coefficients for need scales were in the 50s and 60s (2 of 15 were below .50). Mean scores on 7 of the need scales changed significantly over the seven-week intertest interval. Of the 74 individual profile correlations, 64 were significant; the median value was .75. There was some evidence that low profile stability was related to a low consistency score on one or both administrations. The test-retest data were compared with other reliability studies of the Personal Preference Schedule. Author (TAB)

N68-30752*# Lockheed Missiles and Space Co., Sunnyvale, Calif. Biotechnology Organization.
SIXTY DAY MANNED EVALUATION OF ZERO GRAVITY HUMIDITY CONTROL SYSTEM
Richard W. Joy and Thomas M. Olcott 31 Jul. 1968 47 p ref
(Contract NAS1-5622)
(NASA-CR-66640) CFSTI: HC$3.00/MF$0.65 CSCL 06K

A study of the application of hydrophilic and hydrophobic surfaces for phase separation in low gravity environments began in 1963. A humidity control system using these surfaces was fabricated in 1966 and delivered to NASA/LRC. The previous evaluation program consisted of four parts: development of evaluation criteria and test plan, system integration and checkout, initial steady state tests and test plan modifications, final steady state and performance evaluation testing and test data analysis., and development of optimum design criteria. Upon the successful completion of the evaluation testing of the zero gravity humidity control system, NASA Langley Research Center directed development of a humidity control system for the McDonnell Douglas spacecabin simulator to be used during a 60-day manned test in that simulator. The unit was incorporated into the potable water recovery system for urine and atmospheric condensate. This unit included an aluminum plate-fin condensing heat exchanger, a hydrophobic/hydrophilic water separator and a continuous water delivery system. Author

N68-30783# Royal Aircraft Establishment, Farnborough (England).
INVESTIGATION OF THE STRESS ON FLIGHT CREWS OF JET AIRCRAFT ON LONG-DISTANCE FLIGHTS [UNTERSUCHUNGEN ZUR BELASTUNG DES BORDPERSONALS AUF FERNFLUEGEN MIT DUESENMASCHINEN]
K. E. Klein, H. Bruener, and S. Ruff Jan. 1968 30 p refs Transl. into ENGLISH from Z. Flugwiss (West Germany), v. 14, no. 2, 1966 p 109–121
(RAE-LIB-TRANS-1274) CFSTI: HC$3.00/MF$0.65

Since the introduction of jet aircraft into the civil air traffic aircrew fatigue has often been discussed but few attempts have been made to measure it practically. It is possible to obtain an estimation of the magnitude of aircrew fatigue by comparative measurements of psycho-physiological parameters in aircrew members during regular transatlantic flights and in a control group during sedentary activity in a fixed location. The results seem to allow a quantitative evaluation of occupational stress in physiological terms on various flight routes, and they add, to the knowledge of possible impairment of flight safety by stressfull flights. Author

N68-30796# Texas Christian Univ., Fort Worth.
PARAMETERS OF HUMAN PATTERN PERCEPTION Semiannual Progress Report, Sep. 1967–Mar. 1968
Shelby H. Evans 12 Apr. 1968 25 p refs
(Contract DAAD05-68-C-0176)
(Rept.-1; AD-669861)

An introduction to the research is presented emphasizing the importance of within class variability and common attributes (schema) of a class in the problem of assigning patterns to recognition classes. It is also noted that this research program includes the development of methodologies to allow control and manipulation of this variability as well as of other relevant pattern variables. Subsequent phases of the research will make use of these methodologies in empirical and theoretical developments leading to basic understanding of pattern perception. An integrative summary of previous, present, and projected research is presented. A review is given of progress toward the creation of a research center capable of conducting further research in this area. Author (TAB)

N68-30834*# Scripta Technica, Inc., Washington, D. C.
OXYGEN-GENERATING PROCESS OF A NEW "CHEMICAL" GAS-PROTECTIVE DEVICE [UBER DAS SAUERSTOFFERZEUGUNGS-VERFAHREN EINES NEUEN 'CHEMISCHEN' GASSCHUTZGERATES]
Albert Hloch Washington NASA Jul. 1968 5 p refs Transl. into ENGLISH from Z. Angew. Chem. (Germany), v. 43, 1930 p 732–734
(Contract NASW-1694)
(NASA-TT-F-11702) CFSTI: HC$3.00/MF$0.65 CSCL 06Q

Chemical oxygen-generating devices, employing air regeneration by passage over alkali peroxides or decomposition of alkali chlorates are discussed in connection with their application in gas masks and other breathing apparatus. Author

N68-30845*# Mathematical Sciences Group, College Park, Md.
IDENTIFICATION OF LINEAR SYSTEMS
Thomas S. Englar [1968] 133 p
(Contract NAS12-583)
(NASA-CR-86067) CFSTI: $3.00 CSCL 05H

The approach taken to linear systems analysis is discussed in the context of identifying the human operator by obtaining a linear constant dynamical system which best approximates the human input–output behavior in a particular job. It is assumed that the system to be identified actually is a linear stationary dynamical system. The mathematical methodology involved in the two basic subdivisions is described. These are (1) obtaining the impulse response by projection onto a subspace, and (2) obtaining a canonical realization of the impulse response by application of the Ho algorithm. Details are given on how these methods are mechanized as computational techniques. Numerical implementation is described, and numerical experiments are analyzed. Computer programs are included. M.G.J.

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N68-29673# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
SURFACE RECOMBINATION EFFICIENCES IN FLOWS CONTAINING STEP-FUNCTION INCREASES IN ATOMIC OXYGEN Final Technical Report, 1 Dec. 1964–31 Dec. 1967
A. L. Myerson Mar. 1968 47 p refs
(Contract AF 49(638)-1487)
(CAL-AF-2033-A-1; AFOSR-68-0893; AD-669655)

A study was made of the initial interaction of atomic oxygen with various metals in steady flows which provide a step-function increase, or pulse, in the atom concentration. The observations were made by means of thin-film resistance thermometry. The results are presented under three categories as follows: surface recombination efficiencies, atom concentrations, and recombination heat transfer rate. Author (TAB)

N68-29576 Delaware Univ., Newark.
STUDIES ON THE OXIDATION OF ORGANIC MOLECULES BY MOLECULAR OXYGEN
Raymond Thomas Leibfried, Sr. (Ph.D. Thesis) 1966 85 p
Available from Univ. Microfilms: HC $4.40/MF $3.00 Order No. 67-11729

The mechanism of oxidation of various organic compounds by molecular oxygen were studied using a fast, accurate eudiometric apparatus to measure oxygen uptake. Certain elements of similarity in the oxidation mechanisms of hydrazobenzene, N N dimethyl N' (3 5 di t butyl 4 hydroxy benzyl) hydrazine, diphenylacetonitrile, and dimethylacetonitrile were elucidated by these kinetic studies. In each case a negative species possessing unshared pairs of full anionic character was reversibly complexed by molecular oxygen. This charge transfer complex evidently existed in equilibrium with a periodic component through an electron spin reversal step. The kinetics have shown that the rate determining step of the reaction could be either the spin reversal step to form peroxide or the decomposition of the peroxidic species to products. Dissert. Abstr.

N68-29577 IIT Research Inst., Chicago, Ill.
DISSOCIATION ENERGIES OF GASEOUS DIATOMIC SULFUR, SELENIUM, AND TELLURIUM
Pranas Budininkas (Ph.D. Thesis) 1967 112 p
Available from Univ. Microfilms: HC $5.60/MF $3.00 Order No. 67-12571

A simultaneous Knudsen-torsion technique utilizing a double-oven effusion cell has been developed which permitted the determination of the dissociation energies of diatomic molecules entirely from experimental measurements, without using any *a priori* assumptions. In this method, a torsion effusion cell, made of alumina, was suspended on a tantalum torsion fiber from a balance inside of a high vacuum system. A capillary tube extended down from the bottom of the effusion cell body and ended in a reservoir containing the vaporizing sample. The vapor passed through the capillary tube to the torsion cell which was heated to a temperature high enough to give only diatomic and monatomic species. Therefore, the vapor pressure could be varied by changing the temperature of the reservoir, and the equilibrium constant by varying the temperature of the effusion cell body. Dissert. Abstr.

N68-29583 Princeton Univ., N. J.
ABSOLUTE TRANSITION PROBABILITIES IN ULTRAVIOLET MOLECULAR SPECTRA
James Edward Hesser, Jr. (Ph.D. Thesis) 1967 147 p
Available from Univ. Microfilms: HC $7.00/MF $3.00 Order No. 67-9602

Radiative lifetimes have been measured by the phase-shift technique of Lawrence (1965) for seventeen excited states which emit in the 950 to 4500 Å region in H_2, N_2, N_2^+, CO, CO +, NO, NO +, BF, CF, BCl and CO_2^+. The radiative lifetimes measured range from 0.6 nsec in H_2 to 115 nsec in CO_2^+. The emission spectra were excited by an r.f. modulated electron beam in low pressure gases. Electron excitation spectra of BF_3, CF_4 and SiF_4 gases showed extensive emission "continua," which are probably due to polyatomic emitters; radiative lifetimes were determined for these new emission systems, and additional new systems were observed in BCl_3 and CCl_4. Oscillator strengths and electronic transition moments are discussed extensively for the diatomic transitions, where particular attention is paid to the estimation of electronic and vibrational branching ratios. Dissert. Abstr.

N68-29614 Iowa State Univ. of Science and Technology, Ames.
HEMISPHERICAL SPECTRAL EMITTANCE OF SELECTED RARE EARTH OXIDES
William Raymond McMahon (Ph.D. Thesis) 1967 57 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-12978

The hemispherical spectral emittances for the sesquioxides of yttrium, samarium, gadolinium, erbium, thulium and ytterbium are given for five wavelengths in the visible portion of the spectrum over a temperature range of 1400°K to 3000°K. A reflectance technique incorporating a carbon arc image furnace and a standard of reflectance is used in the determinations. The emittance of zirconium dioxide is determined by the same method and used as a means to check the validity of the method. Dissert. Abstr.

N68-29615 Pittsburgh Univ., Pa.
PORE-DIFFUSION MECHANISMS AS DETERMINED FROM GAS-PHASE ADSORPTION KINETICS
Edward Joseph Nemeth (Ph.D. Thesis) 1967 173 p
Available from Univ. Microfilms: HC $8.00/MF $3.00 Order No. 67-12395

Mathematical models were developed to describe gas-phase adsorption kinetics. The most suitable analysis, based on gas-phase and adsorbed-phase diffusion in the adsorbent pore, led to an alternate development of the Damköhler equation. Equipment was designed and constructed to measure adsorption rates

experimentally, and the data were used to calculate diffusion coefficients. The nitrogen-silica gel adsorption system was used in the experimental work. It was found that the adsorbed-phase diffusivity showed no concentration or temperature dependence in the region of one to 1.5 monolayer surface coverage for this system. The surface-phase diffusion coefficients were found to decrease as the multimolecular coverage increased. In this region, the temperature dependence was such that it was probable that desorption (or evaporation) of the adsorbed molecule controlled the diffusion rate. A method was developed to calculate the relative contributions of the gas and adsorbed-phase transport in the pore. Surface-phase diffusion prevailed at the lower temperatures, and gas-phase diffusion became more dominant at the higher temperatures. Dissert. Abstr.

N68-29634# Royal Aircraft Establishment, Farnborough (England).
CORRELATION OF THE GLASS TRANSITION TEMPERATURES OF POLYACRYLATES, POLYMETHACRYLATES, AND POLYCHLOROACRYLATES WITH THEIR CHEMICAL STRUCTURES
J. M. Barton, W. A. Lee, and Diana O'Mahony Nov. 1967 33 p refs
(RAE-TR-67298) CFSTI: HC $3.00/MF $0.65

Glass transition temperatures (T_Gs) of 67 polymers, including polyacrylates, polymethacrylates, and polychloroacrylates, covering the range 202–398°K, may be calculated from a simple additive equation. The T_Gs, calculated from 30 independent variables, were all within 22°K of the observed values; and within 5°K for 31 of the polymers. These independent variables were used to estimate the T_Gs of 38 polymethacrylates and 8 polyacrylates and to provide a basis for the calculation of the T_Gs of a large number of polymers and copolymers. Author

N68-29675 Baylor Univ., Houston, Tex.
A STUDY OF ALLYL ARYL ETHER CLEAVAGE WITH COMPLEX METAL HYDRIDES AND A COMPLEX METAL ALKIDE
Maria Concepcion Marquez (Ph.D. Thesis) 1967 113 p
Available from Univ. Microfilms: HC $5.60/MF $3.00 Order No. 67-8815

The reaction of lithium aluminum methide with allyl aryl ethers was found to be an alkylative cleavage of the allylic carbon–oxygen bond, forming phenol and the methylated hydrocarbon which was expected from S_N2 type displacement of phenoxide ion by methide ion. The alkylative cleavage yields were significantly increased by the addition of nickel chloride which reacted with the methide reagent to form a finely divided black material which apparently catalyzed the reaction. The cleavage of allyl aryl ethers with lithium aluminum hydride in tetrahydrofuran solvent with a nickel chloride catalyst gave a mixture of saturated and unsaturated hydrocarbon products in addition to phenol. The hydrocarbon products of cinnamyl phenyl ether cleavage were n-propylbenzene and propenylbenzene; the hydrocarbon products of 3 cyclohexenyl phenyl ether cleavage were cyclohexane and cyclohexene. Dissert. Abstr.

N68-29677 Ohio State Univ., Columbus.
SUBSTITUENT EFFECTS IN ORGANOSILICON CHEMISTRY
Douglas Lee Marks (Ph.D. Thesis) 1967 143 p
Available from Univ. Microfilms: HC $6.80/MF $3.00 Order No. 67-10914

The hydroxyl proton chemical shifts of aryl carbinols and silanols in dimethylsulfoxide are shown to be subject to substituent effects. Hammett correlations with the shifts of the carbinols indicate that the magnitude of substituent effects is dependent, in part, on the steric environment at the carbinol carbon. A through space mechanism for transmission of substituent effects in aryl carbinols is presented. Considerably larger substituent effects are observed in aryl silanols than in corresponding carbinols. The oxidation of silanes by both mercuric acetate and ozone is discussed. Relative rate determinations show that both reactions are first order in silane and that the rates of reaction of aryldimethylsilanes are enhanced by electron donating groups. Oxidation by mercuric acetate is more sensitive to the steric environment of silicon than is the oxidation by ozone. Electrophilic attack on silicon is postulated for both oxidations. Dissert. Abstr.

N68-29678 Arizona Univ., Tucson.
OXIDIZING PROPERTIES OF SELENIUM COMPOUNDS
Joe Wade White (Ph.D. Thesis) 1967 65 p
Available from Univ. Microfilms: HC $3.60/MF $3.00 Order No. 67-11365

This dissertation consists of three parts. The first part, the selenium dioxide oxidation of ketones, clarifies the mechanism of this reaction. Deuterium exchange experiments rule out the possibility of a fast and reversible enolization. The selenium dioxide catalyzed oxidation of ketones with hydrogen peroxide is investigated in part two. This oxidative rearrangement was found to be catalyzed by sodium acetate and a mechanism similar to the selenium dioxide oxidation of ketones is proposed. An investigation of the use of selenoxides and seleninic acids as oxidizing agents for organic molecules constitutes the third part of this dissertation. Seleninic acids will oxidize ketones to diketones, methyl ketones to ketoacids, and amines to aldehydes in good yield. Their oxidizing capabilities seem to exceed or at least equal those of selenium dioxide. Dissert. Abstr.

N68-29735 George Washington Univ., Washington, D. C.
EFFECT OF GAS MIXTURE AND PRESSURE ON THE WAVELENGTH AND PROFILE OF THE 633 NM LINE OF NEON EMITTED BY He^3–Ne^{20} DISCHARGE TUBES
Mohamed Fadl Ahmed Fadl (Ph.D. Thesis) 1967 142 p
Available from Univ. Microfilms: HC $6.80/MF $3.00 Order No. 67-10339

The effect of gas mixture and pressure on the wavelength and form of the 633 nm line of neon emitted by He^3–Ne^{20} discharge tubes was determined experimentally. The effect on wavelength was determined by measuring the wavelength of different tubes filled with different mixtures of He^3–Ne^{20} at different pressures and operated at fixed wall temperature. The wavelength was measured with reference to the length standard (606 nm of Kr^{86}), utilizing a Fabry–Perot interferometer. The effect on the broadening of the line was determined using the visibility measurement technique. A Michelson interferometer was used to measure the visibility of the line as a function of optical path difference. The shape of the line was then determined by inverse Fourier transformation of the measured visibility. Dissert. Abstr.

N68-29737 Kansas Univ., Lawrence.
ELECTRODE KINETICS OF ORGANIC REDOX SYSTEMS
Paul Anthony Malachesky (Ph.D. Thesis) 1966 108 p
Available from Univ. Microfilms: HC $5.40/MF $3.00 Order No. 67-10820

The over-all rate at which an electrochemical process occurs at the electrode-solution interface is determined by a number of competing factors. Electron transfer, homogeneous chemical reactions preceding or following electron transfer, and mass transfer all may play a role in the kinetics of an electrode reaction. While kinetic and mechanistic studies of inorganic redox systems are numerous, the amount of information on the electrode kinetics of organic redox systems is relatively sparse. This thesis deals with some aspects of the kinetics of organic electrode reactions. Chapter I is concerned with a simple electrode reaction whose rate-determining step is the over-all reaction in the absence of coupled chemical reactions and adsorption and involves the transfer of n electrons. The electron-transfer theory of R. A. Marcus correlating the homogeneous electron exchange rate of redox pairs with the corresponding heterogeneous (electrode) electron transfer

rates has been applied to a number of inorganic redox systems with fair success. Chapter II reports on the attempted use of the Marcus correlation on some organic redox systems. In Chapters III and IV convective mass transport methods are applied to the kinetics of homogeneous chemical reactions following charge transfer.
Dissert. Abstr.

N68-29769 Oklahoma Univ., Norman.
THE EFFECT OF TEMPERATURE UPON NEAR INFRARED SPECTRA ABSORPTIVITIES
Mohamed Sabry Mohamed Kamhawy (Ph.D. Thesis) 1967 116 p
Available from Univ. Microfilms: HC $5.80/MF $3.00 Order No. 67-11086

Investigations have been made on the effect of temperature upon near infrared absorptivities for some functional groups in dilute solutions. The study was carried out on solutions of water, acetone, and piperazine in two nonpolar solvents. The solvents used were carbon tetrachloride and toluene. The spectra of the solutions in carbon tetrachloride were recorded over the temperature range of +10°C to +49°C while the toluene solutions studied over the wider range +11°C to +80°C. The absorptivities of the functional groups are observed to decrease as the temperature of the solutions is increased. The magnitude of this decrease is found to be dependent upon: (i) the functional group itself, (ii) mode of vibration, and (iii) the solvent used. The effect of temperature upon the absorptivity is not experimentally induced since the same absorbance values were recorded after the cell was cooled back to 25°C, as were found at the beginning before the temperature was altered.
Dissert. Abstr.

N68-29788 Polytechnic Inst. of Brooklyn, N. Y.
PART 1: CONFORMATIONAL EQUILIBRIA OF CYCLIC SULFITES. PART 2: SYNTHESIS AND OXIDATION OF THIOLS
Tzvi Kurtz (Ph.D. Thesis) 1967 120 p
Available from Univ. Microfilms: HC $5.80/MF $3.00 Order No. 67-10946

The variation in the chemical shift of proton resonance of three cyclic sulfites as a function of temperature was studied. The nuclear magnetic resonance spectra of 2 2 dimethyl 1 3 propanediol cyclic sulfite and *meso* 2 4 pentanediol cyclic sulfite did not change significantly on heating from 27 to 200°. This supports the claim that cyclic sulfites are in a rigid conformation, and do not undergo sulfite pyramidal inversion or ring interconversion. The *n.m.r.* spectra of racemic 2 4 pentanediol cyclic sulfite showed that upon heating the two methyl peaks approached each other. This was interpreted as an indication that the S = O group is predominantly in the axial position at room temperature. A temperature effect on the infrared spectrum of this sulfite supported this assignement of position. The model compounds for isotactic and syndiotactic polyvinyl mercaptan, *meso*, and racemic 2 4 pentanedithiol were separated using vapor-phase chromatography. Verification of isomer assignments was obtained by an independent synthesis. *Meso* and racemic 2 4 pentanediol were converted to corresponding *p* bromobenzenesulfonate esters. These, in turn, were reacted with thiocyanate ion to yield the dithiocyanates, which were reduced by lithium aluminum hydride to the corresponding dithiols. The n.m.r. spectra of the two isomers were analyzed and were found to support the isomer assignments.
Dissert. Abstr.

N68-29792 California Univ., Los Angeles.
HEATS OF MIXING OF NONELECTROLYTE SOLUTIONS
David Vernon Fenby (Ph.D. Thesis) 1967 189 p
Available from Univ. Microfilms: HC $8.60/MF $3.00 Order No. 67-11711

Recent work on mixtures of normal saturated hydrocarbons has been extedned to branched hydrocarbons by measuring the heat of mixing for each of the five isomers of hexane with *n*-hexadecane at 25.0°C. The maximum values are 113.7, 184.0, 170.5, 236.0, and 187.5 J mole^{-1} for *n*-hexadecane with *n*-hexane, 2-methylpentane, 3-methylpentane, 2,2-dimethylbutane, and 2,3-dimethylbutane, respectively. These measurements agree reasonably well with the predictions of the Scatchard–Hildebrand solubility parameter theory; they also can be correlated with the energies of vaporization and cohesive energy densities of the hexane isomers.
Dissert. Abstr.

N68-29800 Illinois Univ., Urbana.
STUDIES ON MONOLAYER PROPERTIES: DIFFUSION, VISCOSITY, AND SURFACE FLOW
Robert Otto Mass (Ph.D. Thesis) 1967 280 p
Available from Univ. Microfilms: HC $11.70/MF $3.35 Order No. 67-11883

In the second part of the thesis work a new type of channel viscometer was investigated. Essentially, the method consisted of measuring the rate of circulation in a confined monolayer floating on the surface of a moving substrate. The pertinent flow equations were rigorously solved giving an analytical solution relating the velocity profile in the free surface to a viscosity ratio and the aspect ratio of the channel. Experimental observations of the circulation were used to determine the surface shear viscosity coefficients for several compounds. In the last part of the thesis work growth of monolayers at a stagnation point on the surface of dilute surface-active agent solutions flowing in a channel was investigated. Several models are presented for predicting the growth rate of monolayers based on the properties of the surface-active agent and the hydrodynamics of the channel flow.
Dissert. Abstr.

N68-29806# Ohio State Univ. Research Foundation, Columbus.
STUDY OF EMISSION SPECTRA BY PHASE-DISCRIMINATION METHODS Final Report, 1 Feb. 1965–31 Jan. 1968 1965–31 Jan. 1968
Fred P. Dickey, William H. Rogge, Herman E. Scott, John R. Yane, and John T. White Apr. 1968 63 p refs
(Contract AF 19(628)-4331)
(AFCRL-68-0247; AD-669381)

A detailed report is given of the analysis of the emission spectrum of the OH radical in the regions of the fundamental and first overtone vibration-rotation bands. The observations were made with a high-resolution prism-grating vacuum spectrometer. Reports are also included on work completed on pulsed argon lasers, the emission spectrum of CN obtained by using microwave excitation, and the results of experiments carried out with a selective-frequency CO2 laser.
Author (TAB)

N68-29827 Kansas Univ., Lawrence.
THE MICROWAVE SPECTRUM AND STRUCTURE OF SPIROPENTYL CHLORIDE
Lloyd Martin Woerner (Ph.D. Thesis) 1966 86 p
Available from Univ. Microfilms: HC $4.60/MF $3.00 Order No. 67-10844

The results obtained from an analysis of the microwave spectra of $C_5H_7Cl^{35}$ and $C_5H_7Cl^{37}$ are presented. The rotational constants were determined for both isotopic species. For the Cl^{35} species, the values are A = 5,888.46 ± 0.20 MHz, B = 1,954.67 ± 0.15 MHz and C = 1,703.00 ± 0.20 MHz. Analysis of the quadruple hyperfine structure lead to the following values of the Cl^{35} quadruple coupling constants in the inertial axis system. χ_{aa} = −30.98 ± 0.33 MHz, χ_{bb} = 6.22 ± 0.64 MHz, and χ_{cc} = 24.76 ± 0.31 MHz. A structure was assigned for spiropentyl chloride by the r_0 method.
Dissert. Abstr.

N68-29835# Aeronautical Research Council (Gt. Brit.).
A SURVEY OF THE INFRARED RADIATION PROPERTIES OF CARBON DIOXIDE

J. P. Hodgson (Manchester Univ., Engl.) 1968 86 p refs Supersedes ARC-28645
(ARC-CP-981; PD-3604; ARC-28645; AD-833464; AD-814469)

This paper consists of a survey of theoretical and experimental approaches to the prediction of the low resolution emissivity of an infrared band of a polyatomic molecule. Spectral band models and molecular models are discussed, with carbon dioxide being taken as an example of such a molecule. Author (TAB)

N68-29853*# National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York.
PRESSURE-INDUCED MICROWAVE ABSORPTION IN N_2
W. Ho (North Am. Rockwell Corp. and Columbia Univ.), I. A. Kaufman, and P. Thaddeus [1968] 20 p refs
(Grant NsG-442)
(NASA-TM-X-61027) CFSTI: HC $3.00/MF $0.65 CSCL 07D

Pressure-induced absorption in nitrogen has been studied at a frequency of 9260 MHz over the temperature range 238°K–495°K and to pressures as high as 135 atm. The dielectric loss in compressed N_2 was found to be approximately 100 times smaller in magnitude than that in CO_2, and consequently the sensitivity of the experimental apparatus enabled us only to measure the first term in the virial expansion of the dielectric loss proportional to the square of the density. Author

N68-29857 Purdue Univ., Lafayette, Ind.
STUDIES IN MOLECULAR SPECTROSCOPY
William Maurice Risen, Jr. (Ph.D. Thesis) 1967 442 p
Available from Univ. Microfilms: HC $20.05/MF $5.65 Order No. 67-10246

The infrared spectrum of $Fe(CO)_4I_2$ has been studied in the region 4000-33 cm^{-1}. A calculated spectrum has been found through the application of the localized mode method for obtaining vibrational symmetry coordinates, and the use of many force field elements transferred from other metal carbonyl compounds. The far infrared spectra of tetrahydrofuran solutions of three alkali metal salts of $Mn(CO)_5^-$ have each been found to contain a band whose frequency is cation dependent. Force field calculations, based upon several models for the ion aggregate in which cation vibrations were observed, led to knowledge of the forces acting upon the cations in solution in various cage models. However, those calculations did not permit differentiation between the various aggregate models. A preparation of $HMn(CO)_5$ has been devised to obtain the compound in pure form. Its purity has been demonstrated by mass spectral analysis. Such an analysis showed the standard method to yield impurities along with the $HMn(CO)_5$ produced. Dissert. Abstr.

N68-29862 Polytechnic Inst. of Brooklyn, N. Y.
VINYLCYCLOPROPANE, 1 1 DICHLORO 2 VINYLCYCLOPROPANE AND CYCLOPROPYLACETYLENE: MONOMERS AND POLYMERS
George Walter Halek (Ph.D. Thesis) 1967 150 p
Available from Univ. Microfilms: HC $7.00/MF $3.00 Order No. 67-10942

The purpose of this research was to prepare polyvinylcyclopropane by Ziegler–Natta catalysis, fractionate it, characterize the fractions conclusively regarding stereoregularity, study its behavior towards ring-opening reagents and characterize the products formed to elucidate the factors affecting the fate of the cyclopropyl ring in a polymeric environment. The polymerization and properties of 1 1 dichloro 2 vinylcyclopropane, a vinylcyclopropane bearing electronegative elements, was also examined and cyclopropylacetylene was prepared, identified unequivocally, and polymerized. Synthetic routes to vinylcyclopropane in the high purity required by stereoregular polymerization were also studied. Dissert. Abstr.

N68-29863 Polytechnic Inst. of Brooklyn, N. Y.
CONFORMATIONAL STUDIES OF POLYPEPTIDES CONTAINING AZOAROMATIC AND NITROAROMATIC SIDE CHAINS
Martin Louis Falxa (Ph. D. Thesis) 1967 215 p
Available from Univ. Microfilms: HC $9.70/MF $3.00 Order No. 67-10940

This thesis extends the work of Goodman and Kossoy, who reported that ρ (phenylazo)phenylalanine polypeptides form right-handed helices in dioxane solutions, but are non-helical but regular in trifluoroacetic acid. In dioxane solutions they exhibit Cotton effects associated with the 320–mμ azoaromatic absorption maximum; in trifluoroacetic acid solutions they produce Cotton effects in the 425–mμ absorption region of the conjugate acid of the azoaromatic residue. This study indicates that protonation of the azoaromatic side chains causes side chain-side chain repulsion, which disrupts the polypeptide helix. When the acid content of the solvent mixture is 75 to 85%, the polypeptide chain is in a disordered conformation. In trifluoroacetic acid the side chains are fully protonated. This leads to an extended main-chain structure. In the extended structure the side chains interact influencing the 425–mμ protonated azoaromatic Cotton effect, in a regular manner. Dissert. Abstr.

N68-29864 California Univ., Berkeley.
NUCLEAR MAGNETIC RESONANCE STUDIES OF PLATINUM IN PLATINUM–MOLYBDENUM AND PLATINUM–IRIDIUM ALLOYS
Irwin David Weisman (Ph.D. Thesis) 1967 108 p
Available from Univ. Microfilms: HC $5.40/MF $3.00 Order No. 67-11675

Consideration is given to NMR work on Pt^{195} in dilute Pt based binary alloys with Mo and with Ir. The choice of Mo was accidental; it was found to be present in the only one of several Pt–Au alloys which showed a Pt resonance satellite. Subsequent studies on Pt–Mo alloys confirmed that the Mo was indeed responsible for the satellite structure. The observation that Mo drastically reduces the low temperature susceptibility of Pd in Pd based Mo alloys suggested that the Pt resonance satellites might be connected with a reduction in the susceptibility of the isoelectronic system, Pt–Mo. The Pt NMR spectra were studied at three temperatures (1.19, 4.2 and 77°K) in Pt–Mo alloys containing respectively 0.07, 0.17, 0.22 and 3.2 atomic percent Mo and in Pt–Ir alloys containing respectively 0.02 ± 0.01 and 0.34 atomic percent Ir. Dissert. Abstr.

N68-29931 IIT Research Inst., Chicago, Ill.
LINKAGE ISOMER EFFECTS IN HYDROGEN PEROXIDE OXIDATIONS OF THIOCYANATO COMPLEXES
Anthony James Sadowski (Ph.D. Thesis) 1967 106 p
Available from Univ. Microfilms: HC $5.40/MF $3.00 Order No. 67-10960

The first formation constant, $K_{1,Ga^{3+}}$ of the gallium(III)-thiocyanate system was determined in a perchlorate medium. The reacting system, $Ga(III)/SCN^-/H_2O_2$, was studied kinetically at 25°C and the net disappearance of thiocyanate was found. The reacting system, $Bismuth(III)/SCN^-/H_2O_2$, was also studied kinetically at 25°C and the net disappearance of thiocyanate was found. The reaction of $Cr(OH_2)_5{-}NCS^{2+}$ with H_2O_2 at 25°C was found. No reaction between $(Et_4dien)Pd{-}SCN^+$ and H_2O_2 was observed. However, H_2O_2 prevented the isomerization of $Cr(OH_2)_5{-}SCN^{2+}$, apparently by reacting with the thiocyanate ligand while in the transition state of the isomerization process. It was concluded that thiocyanate is oxidized by hydrogen peroxide theough terminal attack on the ligand, presumably through the sulfur atom. It is speculated that the above reactions occur by two different mechanisms (dependent on the acidity) but that the acid independent reactions have a similar mechanism and likewise the acid

dependent reactions have a similar mechanism. This speculation is based on the similarities of the rate laws and reaction products.
Dissert. Abstr.

N68-29933 Wisconsin Univ., Madison.
NUCLEAR MAGNETIC RESONANCE STUDIES OF HYDROGEN FLUORIDE VAPOR
David Karl Hindermann (Ph.D. Thesis) 1967 126 p refs
Available from Univ. Microfilms: HC $6.20/MF $3.00 Order No. 67-6797

An investigation of the nuclear magnetic resonance (NMR) spectra of hydrogen and deuterium fluoride vapor was carried out. The various relative shielding values for the HF and DF monomer were determined by extrapolation to zero HF (DF) density. Foreign pressure narrowing gases were used at low densities to enhance the signal to noise ratio. In all cases the shifts refer to zero total pressure. The HF–DF shift results from zero point vibration effects. In the fluorine case, the measured HF–F_2 shift was combined with theoretical "diamagnetic" shielding values σ^d to calculate the difference in "paramagnetic" shielding $\Delta\sigma^p$. It is clear that detailed interpretation of chemical shifts should be attempted only after zero point vibration effects have been allowed for. The chemical shift of HF vapor over the entire density range was determined. From the shape of the curve at lower densities, it appears that a dimer is present in significant proportions. In no case was any structure observed in the NMR line either for HF samples or HF–DF mixtures. This indicates that an intermolecular exchange rapid enough to average out HF spin–spin coupling effects and chemical shifts among the various species present occurs in all density regions.
Dissert. Abstr.

N68-29934# Technische Hochschule Munchen (West Germany).
ON REACTIONS OF METAL–CARBON COMPOUNDS WITH THE AZIDE ION [UEBER REAKTIONEN VON METALLCARBONYLVERBINDUNGEN MIT DEM AZID-ION]
Horst Engelmann (Ph.D. Thesis) 1967 83 p refs In GERMAN
CFSTI: HC $3.00/MF $0.65

The chemical behavior of a number of hexacarbonyls of the 6th subgroup ($Cr(CO)_6$, $Mo(CO)_6$) in the presence of tetraethylammonium azide and the reaction of metal carbonyl halogenides of the 7th subgroup with alkali azide are studied. As with tungsten hexacarbonyl, the reaction of $N(C_2H_5)_4N_3$ with the hexacarbonyls of chromium and molybdenum occurs without the substitution of carbon monoxide by azide, but leads directly to the diamagnetic complex anions $[Cr(CO)_5NCO]^-$ and $[Mo(CO)_5NCO]^-$ without the elimination of CO. The reaction kinetics of hexacarbonyls of Cr, Mo, and W with the azide ion are examined using the example of tungsten hexacarbonyl. It is shown that a bimolecular phase determines the reaction speed of $W(CO)_6$ and $N(C_2H_5)_4N_3$, an indication of a direct nucleophile attack by the azide ion on the metal hexacarbonyl. The reaction of rhenium pentacarbonylchloride with sodium azide in THF for 2 hours at 40°C followed by precipitation yields the colorless diamagnetic compound $N(C_2H_5)_4[Re(CO)_3N_3NCO]$. The infrared spectra of these compounds are examined to determine structural characteristics. Transl. by K.W.

N68-29941 Wisconsin Univ., Madison.
STRUCTURAL CHEMISTRY OF SEVERAL TRANSITION METAL-SULFUR AND METAL-ARSENIC COMPLEXES
Donald Loren Stevenson (Ph.D. Thesis) 1967 148 p
Available from Univ. Microfilms: HC $7.00/MF $3.00 Order No. 67-6835

The crystal and molecular structures of four transition metal-sulfur and -arsenic complexes have been determined from three-dimensional single-crystal X-ray structural analyses. A structural determination of $[Ni(TAP)CN^+]_4^-$ was undertaken in order to study the coordination of a tetradenate ligand to a Ni(II) atom. A structural determination of $[C_5H_5MoO]_2S_2$ revealed the first known example of an organometallic complex which contains doubly-bridging sulfur atoms linking two transition metals. Crystals of $[C_5H_5MoO]_2S_2$ are triclinic. A detailed comparison of the structural features of $[C_5H_5MoO]_2S_2$ with those of related oxo-bridged molybdenum systems is given. The X-ray analysis of $[SCo_3(CO)_7]_2S_2$ has established the first known case of a disulfide bridging group symmetrically coordinated to four transition metal atoms. In order to determine the effect of an unpaired electron on the detailed molecular parameters of a metal cluster complex, a structural analysis of $SFeCo_2(CO)_9$ was carried out. Evidence that the unpaired electron in $SCo_3(CO)_9$ occupies an antibonding MO has been shown from this X-ray determination of the isomorphous diamagnetic compound $SFeCo_2(CO)_9$.
Dissert. Abstr.

N68-29943 California Univ., Berkeley.
ON THE MECHANISM OF ELECTROLYTIC GAS EVOLUTION
Huk Yuk Cheh (Ph.D. Thesis) 1967 110 p
Available from Univ. Microfilms: HC $5.40/MF $3.00 Order No. 67-11603

A review on the various steps involved in the formation of a gas phase at an electrode-solution interface and on the mass transfer aspects associated with the overall process is presented. The analogies between electrolytic gas evolution and nucleate boiling are also discussed. Theoretical calculations on the dynamics of asymptotic bubble growth in an initially nonuniform concentration or temperature field are performed. For the case of electrolytic gas evolution, a significant simplification is achieved by noting that the Jakob number for mass transfer is usually small so that the convective transport can be neglected in comparison with the diffusive transport. For the case of nucleate boiling, the parametric solution of Skinner and Bankoff using the thin thermal boundary layer approximation associated with the large Jakob number for heat transfer is applied to obtain numerical solutions. Theoretical calculations for fluid flow and for mass transfer to rising bubbles or drops at both large Re and large Pe numbers are performed using the boundary layer approach of Levich.
Dissert. Abstr.

N68-29959*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PROPERTIES OF SELECTED RADIOISOTOPES: A BIBLIOGRAPHY, PART 1: UNCLASSIFIED LITERATURE
Dale Harris, comp. and Joseph Epstein, comp. Washington 1968 189 p refs
(NASA-SP-7031) CFSTI: HC $3.00/MF $0.65 CSCL 18H

Increasing interest in the application of substantial quantities of radioisotopes for propulsion, energy conversion, and various other thermal concepts emphasizes a need for accurate information describing the nuclear, chemical, and physical properties of these isotopes. This document presents, in a single reference, an annotated bibliography and sets of properties for nine of the more attractive isotopes available for use in power production. These isotopes are: Strontium-90; Cesium-134; Cesium-137; Cesium-144; Promethium-147; Polonium-210; Plutonium-238; Curium-242; and Curium-244.
Author

N68-29976 California Univ., Berkeley.
THERMODYNAMIC AND TRANSPORT PROPERTIES OF WATER VAPOR AND AQUEOUS VAPOR MIXTURES
John Paul O'Connell (Ph.D. Thesis) 1967 466 p
Available from Univ. Microfilms: HC $21.15/MF $5.95 Order No. 67-11653

Theoretical and experimental methods have been applied for the interpretation, correlation, and prediction of the dilute gas properties of pure water vapor and its mixtures with nonpolar gases. In particular, intermolecular potential parameters for water have been tentatively established by using new calculations of pure component and mixture second virial coefficients and of the

collision integrals of transport coefficients, and by using available vapor-liquid equilibrium data and some new experimental vapor-diffusion data. Although the parameter values may be revised when more data become available, the present ones may be used to correlate and predict vapor phase nonideality and transport coefficients for gaseous systems of water and nonpolar substances. In addition, the hydrogen-bonding properties of pure water vapor appear explicitly in the treatment and new quantitative understanding of this phenomena has been gained. Dissert. Abstr.

N68-30044*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ON THE INFLUENCE OF NONUNIFORM MAGNETIC FIELDS ON FERROMAGNETIC COLLOIDAL SOLS
S. Stephen Papell and Otto C. Faber, Jr. Washington Aug. 1968 27 p refs
(NASA-TN-D-4676) CFSTI: HC $3.00/MF $0.65 CSCL 07D

Description of a laboratory method for preparing magnetic sols, composed of ferromagnetic submicrometer particles as a stable colloidal dispersion in *n*-heptane, is presented. A fluid of this nature was subjected to nonuniform magnetic fields in a vertically mounted solenoid type electromagnet. Fluid accelerations of up to 7.2 g's were experienced by the magnetic sol without affecting the stability of the colloid system. Body force measurements were made on fluids containing a range of particle concentrations by weight from 1.58 to 13.41 percent that were subjected to magnetic inductions of from 0 to 2.75 teslas in magnetic gradients up to 22.3 teslas per meter. The relations between magnetic induction, magnetic gradient, particle concentration, and body force were examined, and the data are presented herein. An analysis was made from basic considerations that resulted in a general equation that effectively describes the trends in the data. Author

N68-30058 California Inst. of Tech., Pasadena.
STUDY OF HYDROGEN BONDING BY INFRARED SPECTROSCOPY AND NUCLEAR MAGNETIC RESONANCE. ELECTRON PARAMAGNETIC RESONANCE OF Mn(II) COMPLEXES IN ACETONITRILE
Bing-man Fung (Ph.D. Thesis) 1967 208 p
Available from Univ. Microfilms: HC $9.45/MF $3.00 Order No. 67-6157

The infrared and near infrared spectra of acetic acid, formic acid, HOD and methanol have been studied in several organic solvents. The solvents used were acetone, acetonitrile, dimethylsulfoxide, dioxane, tetrahydrofuran and their perdeuterated analogues. The spectra were characterized on the basis of the formation of 1-1 hydrogen bonded complexes between the proton donors and the solvent molecules. A one-dimensional double minimum potential function was developed and then calculated for each hydrogen bonded complex. The nuclear magnetic resonance of the hydroxyl proton of acetic acid dissolved in acetone, dimethylsulfoxide, dioxane and tetrahydrofuran has been investigated. The results are discussed in terms of the equilibria between the acid monomer, the acid dimer and the acid-solvent complex in dilute solutions of acid. The infrared and near infrared spectra and the nuclear magnetic resonance of the hydrogen biacetate anion have been studied. Potential curve, equilibrium constant and proton chemical shift for this species were calculated. Electron paramagnetic resonance for Mn(II) was studied in acetonitrile. Dissert. Abstr.

N68-30059 Pennsylvania State Univ., University Park.
TRANSIENT PHENOMENA AND DESIGN AND OPERATING VARIABLES IN PREPARATIVE GAS CHROMATOGRAPHY
Dennis Jack Royer (Ph.D. Thesis) 1966 174 p
Available from Univ. Microfilms: HC $8.00/MF $3.00 Order No. 67-11230

Presented are experimental studies of various operating variables affecting the solute elution phenomena and performance of preparative gas–liquid elution chromatography columns. Highest production rates were achieved when samples were injected in a relatively slow, rotary sprayed manner against the inner wall of an essentially empty vaporizer; also, best results occurred for a given sample and sample size when the proper sample injection rate was used. Unsteady state temperature fluctuations produced by passage of solute bands through the column bed were recorded for various sample sizes and injection techniques and provided a means of estimating overall solute band characteristics. Local optimization of production rates in EGS and SE30 columns demonstrated that the production rate increased rapidly with sample size until the maximum separable sample size was approached. Highest production rates resulted when relatively small preparative samples were eluted rapidly through the column. An optimum column temperature was found to exist for the highest production rate for each sample mixture, and production rates increased approximately linearly with carrier gas flow rate over the flow rate range studied. Dissert. Abstr.

N68-30063 IIT Research Inst. Chicago, Ill.
CALCULATION OF ZERO FIELD SPLITTING IN THE NH RADICAL
John Baldwin Lounsbury (Ph.D. Thesis) 1966 164 p
Available from Univ. Microfilms: HC $7.00/MF $3.00 Order No. 67-12207

In view of the great profusion of measurements of zero field splitting (ZFS) parameters by electron paramagnetic resonance (EPR) techniques in the past few years, accurate *ab initio* calculations of these parameters seem desirable. To demonstrate such calculations the $^3\Sigma^-$ and $^3\Pi$ states of NH have been selected for careful analysis. A number of Hartree–Fock–Roothaan one center expansion (OCE) self consistant field (SCF) calculations have been carried out. Analysis of calculated molecular properties, electron and spin densities and comparison with extended basis wave functions indicate that OCE representations of molecular wave functions may account relatively well for properties of a molecule that are dependent on open shell electrons. A general analytical solution is developed for one center electron spin–spin dipolar ZFS integrals. Calculations of the ZFS parameter D arising from spin–spin dipolar interactions have been made for $^3\Sigma^-$ and $^3\Pi$ NH using a variety of wave functions. Spin-orbit coupling contributions to D are estimated for $^3\Pi$ NH and for $^3\Sigma^-$ NH. The total calculated ZFS parameter D for $^3\Pi$ NH is *0.86 cm*, including both spin–spin and spin–orbit contributions. Dissert. Abstr.

N68-30078 Delaware Univ., Newark.
EFFECT OF SURFACTANTS ON MASS TRANSFER RATES AT A GAS–LIQUID INTERFACE
Brian William Bussey (Ph.D. Thesis) 1966 198 p
Available from Univ. Microfilms: HC $9.00/MF $3.00 Order No. 67-11719

A survey of the literature on interfacial resistance has revealed a requirement for research on the effect of surfactants on gas absorption rates in the absence of secondary, complicating phenomena. The oscillating laminar jet technique was used to study the effects of five soluble surfactants on the rate of absorption of carbon dioxide and sulphur dioxide into their aqueous solutions at 25°C. Furthermore, an unsteady-state experiment was designed to measure the effect of surface concentration of Octadecanol, spread as insoluble monolayers, on the absorption of sulphur dioxide into a quiescent water interface. The laminar jet experiments revealed no measurable interfacial resistance for any of the soluble surfactants tested. The results for the unsteady-state experiment using sodium dodecyl sulphate also support this conclusion. The insoluble octadecanol monolayers, however, did produce a significant interfacial resistance. Dissert. Abstr.

N68-30090*# Field Emission Corp., McMinnville, Oreg.
LITERATURE REVIEW OF ADSORPTION ON METAL SURFACES, VOLUME 1 Final Report, 1 May 1966–2 Jul. 1967
L. W. Swanson, A. E. Bell, C. H. Hinrichs, L. C. Crouser, and B. E. Evans 27 Jul. 1967 209 p refs
(Contract NAS3-8910)
(NASA-CR-72402) CFSTI: HC $3.00/MF $0.65 CSCL 07D

Experimental techniques related to adsorption on metal surfaces are reviewed in a literature survey that also summarizes the absorbate-substrate parameters (e.g. energies, activation energies for diffusion, and work function changes due to adsorption and adsorbate density) for a variety of metals. Some quantitative information on dipole moments and sticking coefficients is included. Techniques considered are low energy electron diffraction, flash filament, electron impact desorption, and field electron and ion microscopy. Work function measurements by electron emission methods and by emission contact potential difference methods are described; and experimental and field emission methods for the measurement of binding energy are noted. M.W.R.

N68-30113# Minnesota Univ., Minneapolis. Electrical Engineering Dept.
INVESTIGATION OF STIMULATED RAMAN SCATTERING
Audun Hordvik and R. J. Collins [1968] 203 p refs
(Contract Nonr-710-(61))
(TR-6; AD-669504)

The connection between stimulated Raman scattering and self-focusing was investigated both theoretically and experimentally. Special attention was given to (1) an explanation of the simultaneous occurrence of several order Stokes and anti-Stokes radiation and (2) an anomalous time behavior, which was found to be present, in the higher order Stokes and 1st anti-Stokes radiation, especially in carbon disulfide. The first phenomenon is explained by introducing a distribution of filament lengths, and good agreement is obtained between theory and experiment. It is suggested that the time anomaly is caused by dielectric breakdown, and numerical calculations are carried out showing qualitative agreement with the observed data. Author (TAB)

N68-30132# Hebrew Univ., Jerusalem (Israel). Dept. of Physics.
INVESTIGATION OF COLOR CENTERS AND LUMINESCENCE IN INSULATING CRYSTALS Final Scientific Report, 1 Nov. 1966–31 Dec. 1967
Abraham Halperin, Abraham A. Braner, Z. Cohen, J. Shapira, and E. Zacks Feb. 1968 43 p refs
(Contract F61052-67-C-0039)
(AFCRL-68-0236; AD-669350)

Thermally stimulated luminescence (TSL) and conductivity (TSC) in KBr, x-excited at LAT were measured simultaneously. Most TSL peaks were correlated to TSC peaks. Re-excitation with F-light resulted in high intensity TSC peaks at 143 and 218K and low TSL at 146 and 223K. V light gave different results. Optical bleaching of the F_1 or F-bands increased some and reduced other glow peaks. Hexagonal (6H-alpha SiC) silicon carbide crystals including iron and nitrogen were examined. The absorption showed weak bands at 0.62 and about 0.9 microns. The decay of the blue luminescence nearly fitted a power law with slopes of less than one for decay times up to 2msec. Short wavelength components of the band decayed faster compared with those at longer wavelengths. The TSL showed one glow peak near 115K with an activation energy of 0.12-0.13 ev. The TSL and TSC of a Brazilian natural quartz crystal and a synthetic Ge-doped sample as well as their re-excitation and bleaching effects are also described. Author (TAB)

N68-30136# Bureau of Mines, Bartlesville, Okla. Petroleum Research Center.
THERMODYNAMIC PROPERTIES OF ORGANIC DERIVATIVES OF THE LIGHTER ELEMENTS Annual Technical Summary Report, 1 Mar. 1967–1 Mar. 1968
Donald R. Douslin, William D. Good, Herman L. Finke, Roland H. Harrison, and George B. Guthrie 1 Mar. 1968 30 p refs
(Contract ISSA-67-0008)
(AFOSR-68-0984; AD-669369)

Continued thermochemical research was carried out on ethylenimine as a substance which showed high ring strain and as the parent compound of possible derivatives containing the ethylenimine ring which might show promise as high energy fuels. Programs of thermochemical research on aliphatic diamines were continued in order to better define the C-N thermochemical bond energy. Determinations of the state properties of the fluorocarbons were continued as a means for deriving their intermolecular energies. Results for ethylenimine include: thermodynamic functions in the ideal gas state to 1500K calculated from spectroscopic parameters; vapor pressure measurements; and derived enthalpies of vaporization. Research on the aliphatic diamines included enthalpies of combustion and formation, the C-N thermochemical bond energy, low-temperature heat capacities, third-law entropies, vapor pressures, and enthalpies of vaporization. Research on the state properties and intermolecular energies of fluorine compounds includes correlated values of the vapor pressure of hexafluorobenzene up to the critical, second and third virial coefficients of hexafluoroethane, and reduction of the P-V-T values for hexafluoroethane to standard data forms. Author (TAB)

N68-30165*# National Aeronautics and Space Administration, Washington, D. C.
OLIGOMERIZATION OF ISOPRENE
Kyoichi Suga and Syoji Watanabe Jun. 1968 4 p refs Transl. into ENGLISH from Kogyo Kagaku Zasshi (Tokyo), v. 69, 1966 p 354–355
(NASA-TT-F-11847) CFSTI: HC $3.00/MF $0.65 CSCL 07C

An experiment was conducted on the premise that if the mole ratio of monomer is increased, it is theoretically possible to synthesize the oligomer with low degree of polymerization. Isoprene (1 mole) was added to a solution made from naphthalene (0.5 mole) in tetrahydrofuran and metallic lithium (2 mole). The reaction was stopped by methanol and yield of the isoprene dimer was between 10 and 40%. An experiment is reported in which larger quantities were mixed for three hours. M.W.R.

N68-30168# Oak Ridge National Lab., Tenn. Reactor Chemistry Div.
ELECTRICAL CONDUCTIVITY OF MOLTEN FLUORIDES. A REVIEW
G. D. Robbins 26 Mar. 1968 26 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-2180) CFSTI: HC $3.00/MF $0.65

A review of electric conductivity measurements in molten fluoride systems covering the period 1927 to 1967 was made, with particular emphasis on experimental approach. It is pointed out that the common practice of measuring resistance with a Wheatstone bridge having a parallel resistance and capacitance, R_p and C_p, in the balancing arm can result in considerable error if the relation $R_p = R_s\,[1 - R^2C^2\,(2\pi f)^2]$ is not employed in determining the solution resistance R_s. The frequency dependence of the measured resistance and the practice of extrapolating measured resistances to infinite frequency versus $1\sqrt{f}$ is examined in terms of electrode process concepts. A summary of experimental approaches and results for 56 molten fluoride systems is presented. Author (NSA)

N68-30170# Naval Ammunition Depot, Crane, Ind.
A THEORETICAL TREATMENT OF MIXED SMOKES AS ICE NUCLEI
Duane M. Johnson Apr. 1968 35 p refs
(NAS-CR-RDTR-112; AD-669435)

A proposed nucleation mechanism is described for mixed smokes composed of potassium iodide and silver iodide. The

dynamic dissolution of such smoke particles is considered to be theoretically of significance in the nucleation mechanism of supercooled fogs of water droplets. Author (TAB)

N68-30178# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

DETERMINATION OF EFFECTIVE CHARGES OF IRON ATOMS IN CERTAIN POLYFERROCENES BY X-RAY SPECTRA OF ABSORPTION [OPREDELENIE EFFEKTIVNYKH ZARYADOV ATOMOV ZHELEZA V NEKOTORYKH POLIFERROTSENAKH PO RENTGENOVSTIM SPEKTRAM POGLOSHCHENIYA]

Yu. F. Kopelev and E. Ye. Vaynshteyn 12 Sep. 1967 16 p refs Transl. into ENGLISH from Izv. Sibirsk. Otd. Akad. Nauk SSSR, Ser. Tekhn. Nauk (Novosibirsk), no. 2, 1964 p 3–9
(FTD-MT-66-112; AD-670118)

Results are presented of experimental investigations of the X-ray absorption K-spectra of iron in certain polyferrocenes and of the calculation of effective charges on the central atom and ligands in these compounds. The influence of polymerization on the character of distribution of electron density in the molecule was also studied. Substances investigated were polyferrocene, polybutylferrocene, polydibutylferrocene, polyamylferrocene, and polydiisopropylferrocene. As a result of the experiments a new method is offered for the treatment of X-ray absorption spectra which allows one to determine the ratio eta/n without decomposition of the spectrum into components. The experiments also enabled an estimate to be made of effective charges concentrated on atoms of metal in compounds and clarified the direction of their change in the species of polymers studied. Author (TAB)

N68-30179# Air Force Systems Command, Wright-Patterson AFB, Ohio. Aero Propulsion Lab.

A STUDY OF METHYLCYCLOHEXANE DEHYDROGENATION OVER A PLATINUM-ON-ALUMINA CATALYST AT 602°F Technical Report, Aug. 1966 – Dec. 1967

Alan E. Zengel Apr. 1968 63 p refs
(AFAPL-TR-67-160; AD-670164)

A laboratory reactor was set up and operated as a differential catalytic reactor for a study of the dehydrogenation of methylcyclohexane over an 0.8 weight percent platinum on alumina catalyst. The reactor was operated as a differential reactor; i.e., with only small conversions, in order to reduce the effect of the large endothermic heat of reaction associated with the dehydrogenation of methylcyclohexane. The main tasks were to set up and successfully operate a reactor that could be used in laboratory kinetics studies. It was also necessary to determine the conditions for a study of the chemical reaction rate of methylcyclohexane dehydrogenation that was unencumbered by physical rate-limiting processes. Reactions were run at 76 psia and 602F. The effect of diffusion within the catalyst particle was minimized by using particles that were crushed and screened through a 50 mesh Tyler screen and retained on a 70 mesh Tyler screen. The surface reaction was found to be first order with respect to methylcyclohexane partial pressure under the conditions studied. Although the data are too limited to determine the rate limiting step, a discussion of the rate data along with results reported in the literature for similar rate studies suggests that the conversion of methylcyclohexane to toluene and hydrogen is limited by a single site-surface reaction. Author (TAB)

N68-30188*# National Aeronautics and Space Administration, Washington, D. C.

THE CHEMISTRY OF CONDENSED PHOSPHATES AND ARSENATES. PART 13: THE COURSE OF THE DEHYDRATION OF THE DIHYDROGENMONOPHOSPHATES OF LI, NA, K, AND NH_4 [ZUR CHEMIE DER KONDENSIERTEN PHOSPHATE UND ARSENATE. 13. DER DIHYDROGENMONOPHOSPHATE DES LI, NA, K UND NH_4]

Erich Thilo and Herbert Grunze Jun. 1968 23 p refs Transl. into ENGLISH from Z. Anorg. Allgem. Chem. (Leipzig), v. 281, 1955 p 262–283
(NASA-TT-F-11745) CFSTI: $3.00 CSCL 07B

The course of the thermal dehydration of the dihydrogenphosphates of Li^+, Na^+, K^+ and NH^+_4 was investigated essentially chromatographically in relation to the substances and their dependence on the heating conditions and the H_2O vapor pressure in the surrounding atmosphere. Whereas the various alkali salts behave quite differently in the open air, their behavior becomes very similar at a higher partial pressure of the H_2O. The insoluble condensed phosphates, arsenates and arsenate-phosphates of lithium and condensed ammonium phosphate are found to be high-molecular polymeric compounds with chain anions. Their designation as hexa- or decametaphosphate is not valid and is to be stricken from the literature. Author

N68-30191*# Field Emission Corp., McMinnville, Oreg.

VOLUME 2: LITERATURE REVIEW OF ADSORPTION ON METAL SURFACES Final Report, 1 May 1966–2 Jul. 1967

L. W. Swanson, A. E. Bell, C. H. Hinrichs, L. C. Crouser, and B. E. Evans 27 Jul. 1967 148 p refs
(Contract NAS3-8910)
(NASA-CR-72403) CFSTI: HC $3.00/MF $0.65 CSCL 07D

The objective of this work is to provide a review of existing theoretical models which attempt to describe work functions or ion-neutral desorption energies as a function of surface coverage. The first section of Part I deals with theories of atom and ion desorption energies, the second with work function calculations and the third with calculations of potential energies anywhere in front of either a complete array of discrete ions or along a line perpendicular to a single vacancy in such an array. The complete array results are useful for calculations of work function, especially in the high field situation which occurs in field emission. In this case, the applied field cuts the potential barrier to electron emission from the metal so close to the metal that the barrier is diminished by an amount which is related to the coverage of adsorbate and to the value of the applied field. The incomplete array results on the other hand enable ion desorption energies to be computed as a function of coverage. Not all theories have been reviewed in this work, although it is felt that this review covers most of the main theories of chemisorption, especially those making quantitative predictions of desorption energy and work function. Author

N68-30192# Bureau of Mines, Albany, Oreg. Metallurgy Research Center.

HEATS OF FORMATION OF FOUR ANHYDROUS SODIUM BORATES

Lanford H. Adami and C. J. Joe Aug. 1968 13 p refs
(BM-RI-7167)

Heats of formation were obtained for four anhydrous crystalline sodium borates by hydrochloric acid solution calorimetry. The heats of formation at 298.15°K from the elements are $NaBO_2$, -233.2 ± 0.6 kcal/mole; $Na_2B_4O_7$, -786.4 ± 1.0 kcal/mole; NaB_3O_5, -549.9 ± 0.8 kcal/mole; and $Na_2B_8O_{13}$, $-1,412.5 \pm 2.0$ kcal/mole. The heats of formation from the constituent oxides are $NaBO_2$, -31.5 ± 0.8 kcal/mole; $Na_2B_4O_7$, -78.8 ± 1.3 kcal/mole; NaB_3O_5, -44.1 ± 0.8 kcal/mole; and $Na_2B_8O_{13}$, -96.7 ± 1.5 kcal/mole. Author

N68-30195# Bureau of Mines, Amarillo, Tex. Helium Research Center.

HELIUM-4 EXPERIMENTAL PVT REFERENCES: 1895 TO 1968

Robert E. Barieau Aug. 1968 28 p refs
(BM-IC-8388)

A list of 163 references to original experimental PVT data on helium is presented. Emphasis is placed on its thermodynamic properties, compressibility, and isotherms for gaseous helium mixtures. Author

N68-30202# European Atomic Energy Community, Ispra (Italy). Medical Service.

SIMPLE METHOD OF ASSAYING POLYPHENYLS, ALKYLNAPHTHALENES AND MIXTURES THEREOF IN WORKING ENVIRONMENTS [SEMPLICE METODO DI DOSAGGIO DI POLIFENILI, ALCHILNAFTALINE E LORO MISCELE IN AMBIENTI DI LAVORO]

G. Barassi and V. Camera Brussels Jun. 1968 41 p refs
In ITALIAN; ENGLISH summary
(EUR-3924.I) CFSTI: HC $3.00/MF $0.65

A simple and rapid method for the determination of polyphenyls and alkylnaphthalene in working environments is described. This method is based on the colorimetric reaction between alkylnaphthalene, concentrated sulphuric acid and ferric ions; the polyphenyls require, for the reaction, the addition of formaldehyde. Known quantities of air are bubbled into an appropriate reagent and the optic density is measured at a certain wavelength for the determination of the concentration of the substance. The sensitivity of the method is in function of the substance examined and the quantity of air that is absorbed: for 5 litres of air one can reveal 0.2 mg/m^3 of α-methylnaphthalene and 0.2 mg/m^3 of biphenyl. Author

N68-30208# Oak Ridge National Lab., Tenn. Physics Div.

COULOMB EXCITATION STUDIES OF Pd 104, Cd 106, 108, W 182, 184, 186, Os 186, 188, 190, 192, AND Pt 192, 194, 196, 198

William Thomas Miller (Ph.D. Thesis—Tenn. Univ., Knoxville) May 1968 208 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-2121) CFSTI: HC $3.00/MF $0.65

The low-lying states of some even-even nuclei in the slightly deformed (vibrational) region and the highly deformed (rotational) region were investigated using Coulomb excitation. Transition probabilities and branching ratios were determined. The results were compared with predictions of the asymmetric rotator model, the vibrational model, and the pairing-plus-quadrupole model. NSA

N68-30209*# Scripta Technica, Inc., Washington, D. C.

SELECTIVE EXCITATION OF ARGON IONS BY METASTABLE HELIUM ATOMS [IZBIRATEL'NOYE VOZBUZHDENIYE IONOV ARGONA METASTABIL'NYMI ATOMAMI GELIYA]

V. P. Chebotayev NASA Jul. 1968 5 p refs Transl. into ENGLISH from Izv. Sibirsk. Otd. Akad. Nauk SSSR, Ser. Tekhn. Nauk (Novosibirsk), v. 6, 1964 p 121–124
(Contract NASw-1694)
(NASA-TT-F-11830) CFSTI: HC $3.00/MF $0.65 CSCL 07D

The higher intensity of certain argon spark lines is associated with inelastic collisions of metastable helium atoms with argon ions. Author

N68-30213*# Techtran Corp., Glen Burnie, Md.

THERMOSTABLE SOLUBLE POLYIMIDES [O TERMOSTOYKIKH RASTVORIMYKH POLIIMIDAKH]

V. V. Korshak, S. V. Vinogradova, Ya. S. Vygodskiy, S. A. Pavlova, and L. V. Boyko Washington NASA Jul. 1968 10 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Khim. (Moscow), no. 10, 1967 p 2267–2274
(Contract NASw-1695)
(NASA-TT-F-11768) CFSTI: HC $3.00/MF $0.65 CSCL 07C

A new method is developed for synthesizing high-molecular aromatic polyimides—single-stage high-temperature polycyclization in solution—which considerably simplifies the synthesis and use of such polymers. An idea of the molecular structure and coefficient of polydispersity of the polyimides is obtained for the first time on the basis of polydiphenylene-phthalide pyromellitimide as an example. Some physicochemical properties of anilinephthalein imide and anilinephthalein polyimides are studied, and it is found that these polymers have a valuable set of properties: high mechanical indices and exceptional thermal stability, which, when combined with the excellent solubility of the given polyimides, make them extremely promising for practical use. The problem of the effect which various structural factors have on the solubility of the polyimides is discussed, and it is shown that the solubility of anilinephthalein imide and anilinephthalein polyimides is due to the large size and the polarity of the phthalide and phthalimidine side groups. Author

N68-30232# Oak Ridge National Lab., Tenn.

JACOBI–GAUSS QUADRATURE CALCULATIONS OF RYDBERG–KLEIN POTENTIAL ENERGY CURVES FOR DIATOMIC MOLECULES AND SOLUTIONS OF THE ENSUING WAVE EQUATIONS FOR SOME OF THEIR BOUND STATES

J. W. McKeever (M.S. Thesis—Tenn. Univ., Knoxville) and H. C. Schweinler May 1968 170 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-2167) CFSTI: HC $3.00/MF $0.65

A method, originally advanced by Rydberg and Klein, for calculating the potential energy for nuclear motion of a diatomic molecule by using the total energy as a function of the vibrational and rotational quantum numbers was integrated by Gaussian-Jacobi numerical quadrature. Precision of 1 part in 10^7 was obtained, after an analytical correction, between the potential energies of two solvable problems and the potential energies calculated from the eigen energies of these problems using the Rydberg–Klein method. The computer program was used to obtain the potential energy of $H^{81}Br$ using a set of Dunham constants for this molecule, which had been measured by Rank, Fink, and Wiggins. Then the corrected potential energy curve, adjusted so that its minimum was zero, became input to the radial equation. The wave equation was solved for its eigen energies at states described by all pairs of vibrational quantum numbers 0, 1, 2, and 3 and rotational quantum numbers 0, 10, 20, and 30. The calculated eigen energies were between 0.1 and 0.2 cm^{-1} from the observed values. Of these calculated values only the energy eigenvalue for the (3,0) state was further from the observed value than was the value from the uncorrected potential input curve. The correction improved the calculated eigen energies from 0.03 cm^{-1} for the lowest energy states to 0.3 cm^{-1} for the highest energy states considered. Dissert. Abstr.

N68-30257*# University of Southern Calif., Los Angeles. Dept. of Physics.

ABSORPTION COEFFICIENTS OF OXYGEN AT THE LYMAN-ALPHA LINE AND ITS VICINITY

M. Ogawa [1968] 11 p refs
(Grant NGL-05-018-044)
(NASA-CR-95881) CFSTI: HC $3.00/MF $0.65 CSCL 07D

Using a 3-m vacuum spectrometer, absorption coefficients of O_2 at the Lyman-alpha line and its vicinity have been remeasured between 1214.8 and 1217.8 A. Coefficients at the wavelengths

of the apparent doublet peaks of the Lyman-alpha line, caused by self-absorption and separated by 0.09 A, are pressure independent at relatively low pressure ($p \leq 6.3$ torr). The absorption coefficient at the shorter wavelength peak is 0.304 ± 0.002 cm^{-1} and that at the longer wavelength peak 0.278 ± 0.002 cm^{-1}. The minimum of the transmission window is located at about 1216.0 A and its value is 0.254 cm^{-1}. Author

N68-30262# Atomic Energy Commission, Washington, D. C.
RADIOISOTOPES: PRODUCTION AND DEVELOPMENT OF LARGE-SCALE USES
May 1968 45 p *Its* Wash No. 1095
CFSTI: HC $3.00/MF $0.65

Systems using radioactive isotopes as sources of heat and radiation are described. Its applications to spacecraft power and propulsion, terrestrial electric power generation, and chemical processing and production are reported. Special emphasis is placed on radioisotope batteries and other SNAP power generators. Author

N68-30265# Philco-Ford Corp., Newport Beach, Calif. Aeroneutronic Div.
ABSORPTION BY CARBON DIOXIDE BETWEEN 1/3100 AND 1/4100 cm (2.44-3.22 MICRONS)
Darrell E. Burch, David A. Gryvnak, and Richard R. Patty 30 Apr. 1968 34 p *refs*
(Contract Nonr 3560(00); ARPA Order 237)
(U-4132; AD-669468)

The absorption by CO2 between 3100 and 4100 cm-1 has been studied with a spectrometer whose spectral slitwidth was approximately one-half cm-1. Spectral curves were obtained for 26 samples of CO2 and CO2 + N2 with pressures as high as 14.6 atmospheres and with paths as long as 933 meters. Several absorption bands not observed previously in laboratory spectra have been identified and the strengths of several bands have been determined. Absorption between 3770 and 4100 cm-1 by the extreme wings of strong lines at lower wavenumbers has been investigated for self-broadened and N2-broadened lines. Spectral curves and extensive tables have been included for most of the samples. Author (TAB)

N68-30278# Nuklearni Institut Jozef Stefan, Ljubljana (Yugoslavia).
PRESSURE SYNTHESIS OF URANIUM HEXAFLUORIDE [DRUCKSYNTHESE VON URANHEXAFLUORID]
J. Slivnik, A. Smalc, and B. Zemva Feb. 1968 7 p In GERMAN Presented at EUCHEM Inorg. Fluorine Conf., Leicester, Engl., 10–12 Apr. 1967
(NIJS-R-525) CFSTI: HC $3.00/MF $0.65

Described is the pressure synthesis of uranium hexafluoride from tri-uranium octoxide and fluorite in a molecular concentration of $U:F_2 = 1:90$ in the absence of an activator. Results of various runs at differing temperatures up to 500°C showed an increase of obtained uranium hexafluoride at increasing temperatures after 12 hrs at 140°C. Transl. by G.G.

N68-30284# European Atomic Energy Community, Karlsruhe (West Germany). European Inst. for Transuranium Elements.
THE DETERMINATION OF FREE ACIDITY IN PLUTONIUM CONTAINING SOLUTIONS AND THE SEMI-QUANTITATIVE ACIDIMETRIC ESTIMATION OF PLUTONIUM
K. Buijs, B. Chavane de Dalmassy, and M. J. Maurice Brussels Jun. 1968 12 p *refs*
(EUR-3934.e) CFSTI: HC $3.00/MF $0.65

A fast method for the analysis of free acid in plutonium solutions has been developed. An ammonium fluoride solution provides the medium in which hydrolysis of plutonium is prevented. Author

N68-30341# Universidad Nacional Autonoma de Mexico, Villa Obregon. Facultad de Ciencias.
THE CROSS SECTION DETECTOR AND ITS APPLICATION IN THE ANALYSIS OF GASES [EL DETECTOR DE SECCIONES TRANSVERSALES Y SU APLICACION EN EL ANALISIS DE GASES]
Jose Luis Del Campo Maldonado 1967 56 p refs In SPANISH
(NP-17355)

The physical principles on which ionization chambers are based are described. Some fundamental aspects of gas chromatography and the apparatus used are also considered. The design of a flowthrough ionization chamber with an internal standard radiation source for gas analysis is presented. Experimental results are presented. NSA

N68-30347# Stockholm Univ. (Sweden). Inst. of Inorganic and Physical Chemistry.
STUDIES ON STRUCTURAL RELATIONS IN CRYSTALLINE AND VITREOUS COMPOUNDS Final Technical Report
Peder Kierkegaard, Stig Axrup, Mats Israelsson, Gunilla Barving, Lars Kihlborg et al Mar. 1968 155 p refs
(Contract DAJA37-67-C-0421)
(AD-669749)

Studies on the structural properties of crystalline and vitreous polymolybdates and polywolframates were performed. Results obtained from X-ray studies on sodium dimolybdate and diwolframate are reported and discussed. Details of the structural investigation of dipotassium tetrawolframate are given. The research work also comprised some studies on glasses and crystalline substances on arsenate molybdate (wolframate) basis containing alkali or silver atoms. Structural data are given for the crystalline compounds NaZr2(PO4)3 and U(PO3)4. Studies on the structural conditions in the ternary oxide systems containing vanadium and molybdenum or wolfram have been performed. Description of the structures are given for the crystalline phases (Mo0.93V0.07)5O14, W0.375V0.625O2.5 and W0.35O0.65O2.5. Preliminary results are given for investigations of copper wolfram oxides. X-ray investigations have been performed on the compounds CuWO4-x and Cu3WO6. The preparation and properties of amorphous molybdenum trioxide are described. A summary of the types of calculations carried out by computer within this research project is given. Apparatus and measuring techniques for studies of magnetic susceptibility of vitreous and crystalline specimens were developed. Measurements over the temperature region 90K-298K have been performed on the crystalline compounds MoOPO4 and W2O3(PO4)2 and glasses prepared from these phases. The crystals of MoOPO4 were found to be paramagnetic while the other compounds are diamagnetic. Author (TAB)

N68-30353*# Techtran Corp., Glen Burnie, Md.
STUDY OF INFRARED ABSORPTION SPECTRA OF SOLIDS BY THE POWDER METHOD. (ACETATES, FORMATES, OXALATES, ACETYLACETONATES, SULPHATES) [ETUDE DES SPECTRES D'ABSORPTION INFRAROUGE DES SOLIDES PAR LA METHODE DES POUDRES. (ACETATES, FORMIATES, OXALATES, ACETYLACETONATES, SULFATES)]
Jean Lecompte and Rene Freymann Washington NASA Jul. 1968 3 p ref Transl. into ENGLISH from Compt. Rend. Acad. Sci. (Paris), v. 208, 1939 p 1401–1403
(Contract NASw-1695)
(NASA-TT-F-11798) CFSTI: HC $3.00/MF $0.65 CSCL 07D

The study of the spectra of powdered solids is shown to be as easy as the study of liquid spectra. The powder is spread on sheets of rock salt or potassium bromide and studied between 6 and 20 μ. This method avoids the danger of melting and facilitates the examination of insoluble and opaquely soluble compounds. The powder method with infrared absorption techniques presents a very extensive research area in all types of chemistry. Author

N68-30356 Alfred Univ., N. Y. Coll. of Ceramics.
CATALYTIC REACTIONS OF HYDROGEN ON TITANIUM AND SILICON DIOXIDES
Jesse Ray Harris (Ph.D. Thesis) 1967 166 p
Available from Univ. Microfilms: HC $7.80/MF $3.00 Order No. 67-12033

The kinetics of the ortho-parahydrogen conversion and the hydrogen-deuterium equilibration reactions were investigated on anatase, quartz, cristobalite, and silicic acid. The products of the equilibration reaction were analyzed by mass spectrometry and a microthermal conductivity gauge was used to analyze the products of the conversion reaction. All of the catalysts investigated were active in catalyzing both reactions at temperatures from 93°K to 773°K. The conversion reaction at low temperatures (T <233°K) involved a physical mechanism, while the equilibration reaction involved a chemical mechanism of the Eley–Rideal type. At temperatures above room temperature both reactions involved a chemical mechanism and a Bonhoeffer–Farkas mechanism is favored. No definite relationships could be developed to distinguish between the activities of the different forms of silica. In general, the crystalline forms were more active in catalyzing both reactions.
Dissert. Abstr.

N68-30357 Florida Univ., Gainesville.
THE GAMMA RADIOLYSIS OF CARBON TETRACHLORIDE AND AMMONIA SOLUTIONS
Douglas Dale Davis (Ph.D. Thesis) 1966 103 p
Available from Univ. Microfilms: HC $5.20/MF $3.00 Order No. 67-12918

Gamma radiolysis of solutions of carbon tetrachloride and ammonia has showed that the major products formed are ammonium chloride, ammonium dicyanamide, and hexachloroethane. The G values for these products include cyanoguanidine, guanidine hydrochloride and nitrogen formed with G value yields of .48, .53, and .80, respectively. These observations together with those from several related studies (e.g., high pressure mass spectrometry, UV photolysis, microwave induced decompositions, radical scavenger experiments, and studies on the thermally induced reactions of cyanogen bromide and ammonia) have led to the following conclusions concerning the gamma radiolysis of carbon tetrachloride-ammonia solutions: (1) the large G value of ammonium chloride does not indicate a chain process but merely reflects the stoichiometry of the reaction; (2) trichloromethylamine, dichloromethyleneimine, cyanogen chloride, and cyanamide are all chemically reactive intermediates which are part of a reaction sequence leading to the formation of the organic nitrogen compounds; (3) both ionic and free radical processes lead to the formation of trichloromethylamine; and (4) the absence of hydrazine as a major radiolysis product is due to secondary reactions involving NH_2 radicals.
Dissert. Abstr.

N68-30386*# Scripta Technica, Inc., Washington, D. C.
THE PRODUCTION OF GASEOUS OXYGEN FROM SALTS CONTAINING ACTIVE OXYGEN. [DIE ERZEUGUNG VON GASFORMIGEM SAUERSTOFF AUS SAUERSTOFFAKTIV-SALZEN]
A. Hloch NASA Jul. 1968 4 p refs Transl. into ENGLISH from Chemiker Z. (Heidelberg), v. 57, no. 56, 1933 p 553–554
(Contract NASw-1694)
(NASA-TT-F-11708) CFSTI: HC $3.00/MF $0.65 CSCL 07A

Small scale production of high-purity oxygen for special applications, starting from chlorates or alkali peroxides, was described.
Author

N68-30392# Universidad Nacional Autonoma de Mexico, Villa Obregon. Facultad de Quimica.
USE OF GAMMA-EXCITED X-RAY BEAMS FOR MEASUREMENT OF THE THICKNESS OF ELECTROLYTIC DEPOSITS [UTILIZACION DE FUENTES DE RAYOS X POR EXCITACION CON RAYOS GAMMA, PARA LA DETERMINACION DE ESPESORES DE DEPOSITOS
Fernando Iturbe Hermann 1967 69 p refs In SPANISH
(NP-17351)

A review is given of atomic structure with respect to the excitation of X-rays. The characteristics of X-rays and their production are described. The X-ray sources using γ excitation are described in some detail. The application of these sources to the measurement of thicknesses is illustrated with some examples.
NSA

N68-30412# Atomic Energy Board, Pretoria (South Africa).
THE PROBLEM OF BONDING IN THE URANIUM NITRIDES
N. Segal (Witwatersrand Univ.) and Sebba (Witwatersrand Univ.) Dec. 1967 16 p refs
(PEL-165)

Phase relationships, general properties, and the electronic structure of uranium nitrides are discussed, including theory of bonding in the refractory hard metals and the classification of uranium nitrides and carbides as refractory hard metals.
NSA

N68-30417# Naval Radiological Defense Lab., San Francisco, Calif.
AN ANALYTICAL GAS CHROMATOGRAPH FOR PRODUCTS OF ISOTHERMALLY DEGRADED POLYMERS
John R. Nichols and Anne E. Lipska 5 Feb. 1968 41 p refs
(USNRDL-TR-68-41; AD-669784)

A commercial gas chromatograph was modified to simultaneously analyze parallel inputs of organic compounds and fixed gases originating as the degradation products of isothermally pyrolyzed alpha-cellulose. The pyrolysis chamber and a complex gas-handling system for separating and concentrating the pyrolyzates were attached directly to the chromatograph cabinet, and a complete system of temperature control zones was established. A detailed description of the arrangement and operation of (1) an isothermal pyrolysis chamber for sample generation, (2) a temperature control and valving system for sample separation and concentration, and (3) a parallel liquid partition and solid adsorption gas chromatography system for sample analysis is presented. The technique is applied to trial analysis of the degradation products of white alpha-cellulose pyrolyzed isothermally for 10 minutes in a nitrogen-fluidized sand bath at 360C.
Author (TAB)

N68-30428*# National Aeronautics and Space Administration, Washington, D. C.
MEASUREMENT OF VISCOSITIES OF GASES AT HIGH PRESSURE. PART 2: VISCOSITIES OF NITROGEN AND MIXTURES OF NITROGEN AND HYDROGEN
Hiroji Iwasaki Jul. 1968 13 p refs Transl. into ENGLISH from the Tohoku Univ. Res. Inst. Sci. Rept. (Japan), Ser. A, no. 6, 1954 p 296–307
(NASA-TT-F-11839) CFSTI: HC $3.00/MF $0.65 CSCL 07B

Measurements of the viscosities of nitrogen, 80.4% N_2–19.6% H_2 system and 31.9% N_2–68.1% H_2 system have been made within the error of about 1 per cent, using the modified oscillating disc method. The experimental equations for viscosity-density isotherms were derived using the measured values. These equations reproduce them within the experimental accuracy. Calculating from the measured values, it was found that the deviations of the viscosities of binary mixtures from those made equal to the molar average of the viscosities of the components of the mixture are independent of the pressure within the experimental accuracy over the whole measured ranges and are the function of the temperature and the concentration ratio of components.
Author

N68-30456# Massachusetts Inst. of Tech., Cambridge. Dept. of Chemical Engineering.
CATALYTIC PROPERTIES OF SEMICONDUCTORS Final Report, 1 Feb. 1967–1 Feb. 1968
Raymond F. Baddour and Charles W. Selvidge 1 Mar. 1968 23 p refs
(Contract Nonr-3963(04))
(AD-669691)

The design of a high vacuum flow reactor for investigating the catalytic activity and surface chemical composition of clean surfaces is described. Results obtained applying such a system to the study of the interaction between clean silicon and germanium surfaces and ethanol and formic acid vapors are reported. Author (TAB)

N68-30486# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SYNTHESIS OF CHLORINE-SUBSTITUTED POLYTERPENE ADDITIVES FOR LUBRICATING OILS [O SINTEZE PRISADOK K SMAZOCHNYM MASLAMA NA OSNOVE KHLORZAMESHCHENNYKH POLITERPENOV]
V. A. Proskuryakov and Ya. F. Mayakova 15 Sep. 1967 9 p refs Transl. into ENGLISH from Tr. Leningr. Tekhnol. Inst. Im. Lensoveta (Leningrad), no. 63, 1964 p 192–195
(FTD-HT-67-256; AD-670105)

One of the current trends in the use of the terpene chlorides is their use as chemically active additives to lubricating oils. In order to obtain viscous products of this type, a study was made of the polymerization of a byproduct from the production of geranylchloride at atmospheric pressure and temperatures varying from room temperature to 250C in the presence of catalysts. TAB

N68-30487# Western Ontario Univ., London. Dept. of Chemistry.
TEMPERATURE DEPENDENCE OF F CENTER ABOSRPTION IN KBR AND NABR
Patrick W. M. Jacobs and A. Krishna Menon May 1968 35 p refs
(Contract N00014-66-C-0142)
(AD-669494)

The absorption due to F centers in X-irradiated KBr and NaBr was measured over a wide range of temperatures from 4 to 370K. In NaBr (which is exceedingly difficult to colour) there is also formed a well isolated M band without the usual difficulty of overlapping R bands and so the temperature-dependence of the shape of this M band could also be determined accurately. The difficulty of the overlapping K band was dealt with in two ways: by Gaussian plots of the untreated data (after background subtraction) and by a computer resolution of the F and K bands. The latter calculations confirm the asymmetry of the K band. The half-widths of the F and M bands obey the usual formula for the variation of H with temperature and from the temperature-dependence of the half-widths, values of the effective ground state frequency were obtained. To what extent this represents a genuine local mode remains unresolved. There is some evidence for structure in the K band at low temperatures. Author (TAB)

N68-30479# Eidgenossische Technische Hochschule, Zurich (Switzerland).
ON THE INFLUENCE OF IONIZED RADIATION ON PLASTICIZERS AS USED IN TECHNICAL POLYVINYL CHLORIDE COMPOUNDS. [UEBER DEN EINFLUSS IONISIERENDER STRAHLUNG AUF WEICHMACHER, WIE SIE IN TECHNISCHEN POLYVINYLCHLORIDMISCHUNGEN VERWENDET WERDEN]
Jean-Blaise Ansermoz (Ph.D. Thesis) 1967 124 p refs In GERMAN *Its* Dissertation No. 3944
CFSTI: HC$3.00/MF$0.65

The theoretical part of this study contains a survey on radiochemistry with emphasis on polyvinyl chloride and its most important technical plasticizers. Experimental work centered on the physical and chemical property changes in electron irradiated plasticizers as function of radiation dosage and in comparison with gamma irradiation effects. Evaluated were electrical conductivity, tangent of the dielectric phase angle difference, viscosity, acidity, and refractive index. Analyses of the infrared spectra obtained from all substances showed certain differentiations between the studied plasticizers that could be used for their application in various technical polyvinyl chloride mixtures. Transl. by G.G.

N68-30486*# Techtran Corp., Glen Burnie, Md.
INVESTIGATION OF THE SURFACE STATE OF NICKEL AND IRON CATHODES FROM THE DROP IN POTENTIAL AFTER DISCONNECTING THE CURRENT [ISSLEDOVANIYE SOSTOYANIYA POVERKNOSTI NIKELEVOGO I ZHELEZNOGO KATODOV PO SPADU POTENSIALA POSLE VYKLYUCHENIYA TOKA]
V. E. Past and Z. A. Iofa Washington NASA Jul. 1968 11 p refs Transl. into ENGLISH from Zh. Fiz. Khim. (Moscow), v. 33, no. 6, 1959 p 1230–1237
(Contract NASw-1695)
(NASA-TT-F-11770) CFSTI: HC$3.00/MF$0.65 CSCL 07D

Oscillographic curves for the drop in potential after disconnecting the current are used for studying the surface state of cathodically polarized nickel and iron. It is shown that the capacitance of nickel and iron cathodes, as computed from the curves for the potential drop, depends on the electrode potential and on the time elapsed from the instant when the polarizing current is switched off. The increase in capacitance as the cathode potential drops is due to the reaction of ionization of adsorbed electrochemically active hydrogen, the quantity of which increases with a reduction in cathodic polarization. The relatively low capacitances as compared with that of a hydrogen condenser plate show that only a small area of the nickel and iron electrode surface is covered with absorbed hydrogen which can be ionized in the given potential range. Surface coverage by electrochemically active hydrogen is low in an acid medium and somewhat greater in an alkali solution. Author

N68-30495# Bureau of Mines, Tuscaloosa, Ala. Metallurgy Research Lab.
PURIFICATION AND CONCENTRATION OF A CYCLIC MANGANESE LEACH SOLUTION BY ELEVATED PRESSURE-TEMPERATURE METHODS
F. E. Brantley, E. K. Landis, and W. R. Cureton Aug. 1968 11 p refs
(BM-RI-7166)

Optimum autoclaving conditions were determined for separation of iron and manganese values from pregnant leach liquor produced in extracting manganese from low grade umber ore. The umber was leached with a synthetic anolyte similar to a recycle solution, used in manganese electrolysis cell operations, that had been renewed with ferrous sulfate and sulfuric acid. The equipment used and results obtained are presented for the several conditions employed. The kinetics of the separation were studied. Rate equations were derived for the formation of solid ammonium–manganese sulfate, $(NH_4)_2Mn_2(SO_4)_3$. Author

N68-30515# Eidgenossische Technische Hochschule, Zurich (Switzerland).
THE INFLUENCE OF ELECTRIC FIELDS IN ORGANIC SINGLE CRYSTALS ON FLANE MOUNTED PARAMAGNETIC METAL COMPLEXES [DER EINFLUSS VON ELEKTRISCHEN

FELDERN IN ORGANISCHEN EINKRISTALIEN AUF EINGEBAUTE EBENE PARAMAGNETISCHE METALLKOMPLEXE]
Guenther Rist (Ph.D. Thesis) 1967 84 p refs In GERMAN *Its* Dissertation No. 3848
CFSTI: HC$3.00/MF$0.65

Paramagnetic electron resonance spectra of plane copper compounds incorporated into the lattices of diamagnetic crystals were studied at molecular combination ratios of 1000 : 1 up to 500 : 1 of matrix substance-metal compound compositions. Substituted copper complexes in oxychinoline, oxychinaldine, and picolinic acid matrices could not be identified because the matrix lattices did not effect the interaction between free electrons and ligand kernels. Transl. by G.G.

N68-30520# Eidgenossische Technische Hochschule, Zurich (Switzerland).
PHOSPHINE COMPLEXES OF METALS [PHOSPHINOKOMPLEXE VON METALLEN]
Max Meier (Ph.D. Thesis) 1967 66 p refs In GERMAN *Its* Dissertation No. 3988
CFSTI: HC$3.00/MF$0.65

Thermodynamic stability measurements on diethyl-oxyethyl-phosphine (Dop) compounds with copper (I), silver (I), mercury (II), and methyl mercury showed similarity with the behavior of the cyano-compounds of these metal ions. Copper, silver, and mercury each added three phosphine molecules in separate steps contrary to the behavior of amines. Cadmium (II) added three ligands in overlapping steps without the formation of a 1:4 compound; with zinc (II) only the 1:2 complex $Zn(Dop)^{2+}_2$ was obtained. Experiments with Cobalt (II) and nickel (II) showed only a light Dop addition and formation of $Co(Dop)^{2+}$, and the nickel reaction quickly lost its binding energy. Transl. by G.G.

N68-30533# Naval Radiological Defense Lab., San Francisco, Calif.
NEUTRON TOTAL CROSS SECTION MEASUREMENTS OF S AND FE NEAR 2 MEV
James M. Ferguson 23 Apr. 1968 30 p refs
(USNRDL-TR-68-50; AD-670478)

The neutron total cross sections of sulfur and iron were measured from 1.8 to 2.6 MeV with energy resolution of a few keV. The cross sections of both elements show fluctuations with widths of the order of 10 keV. For sulfur, the properties of the fluctuations are in good agreement with predictions based on the statistical variations of the compound nuclear levels. For iron, the measured amplitudes are somewhat lower than the predictions. Author (TAB)

N68-30538# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
OPTICS AND SPECTROSCOPIC PROPERTIES OF RARE EARTH OXIDES IN INORGANIC GASES. 2. ABSORPTION SPECTRA OF TRIVALENT RARE EARTH IONS
F. H. Kan, C. H. Chiang, and E. S. Tsia 19 Sep. 1967 13 p refs Transl. into ENGLISH from K'o Hsueh T'ung Pao (Peking), no. 12, 1963 p 41-44
(FTD-HT-67-220; AD-670106)

The absorption spectra of 12 rare earth ions (Ce(3+) to Yb(3+)) in silica glass were determined at wave lengths of 0.25-5.0 microns using glass of the basic composition 25Na2O.75SiO2 plus 0.24Tr2O3 where Tr is the transition element. The specific peak absorption wavelength, frequency, energy level and vibration energy of the rare earth ions are tabulated. The absorption spectrum of Nd(3+) was also investigated in fluoride, phosphate, borate, and silica glass. TAB

N68-30540# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
INCREASING THE SENSITIVITY OF THE SPECTROGRAPHIC DETERMINATION OF SOME TRACE ELEMENTS
F. I. Trishin and M. A. Zhdanova 12 Mar. 1968 10 p refs Transl. into ENGLISH from Izv. Vysshykh Uchebn. Zavedenii, Khim. i Khim. Tekhnol. (Ivanovo), no. 2, 1964 p 383-387
(Contract NOw-62-0604-c)
(TG-230-T548; AD-669935)

The possibility of increasing the sensitivity of the spectrographic determination of trace elements such as copper, cobalt and zinc was investigated by using a porous electrode and varying the operating conditions of the high-voltage spark generator. Author (TAB)

N68-30557# Michigan Technological Univ., Houghton. Dept. of Chemistry and Chemical Engineering.
THE USE OF THE ION ACTIVITY FUNCTION IN SOLUTION KINETICS. 1: THE KINETICS OF HYDROCHLORIC ACID CATALYZED ESTER HYDROLYSIS
Leslie Leifer and Fred D. Williams 15 Mar. 1968 17 p refs Presented at the 155th Natl. Meeting of the Am. Chem. Soc., San Francisco
(Contract AT(11-1)-1712)
(COO-1712-2; CONF-680308-5) CFSTI: HC$3.00/MF$0.65

A study of acid-catalyzed hydrolysis reactions by use of the concentration of formal species in aqueous acid solvent systems is presented. This procedure resulted in more linear relationships when compared with previously accepted data. Where data were available, two distinct ester hydrolysis reactions were separated kinetically; one involving $H_9O_4^+$, the other H_3O^+. The acidity measurements and necessary thermodynamic data for the evaluation of acid profiles were obtained at 25°C. Results are presented for the hydrolysis of γ-butyrolactone, ethyl acetate, methyl formate, ethylidene, methylidene, and ethyl acetoacetate and the lactonization of γ-hydroxybutyric acid. NSA

N68-30560# Navy Dept., Washington, D. C.
THE THERMOCHEMISTRY OF TRINITROMETHANE [TERMOKIMIYA TRINITROMETANA]
E. A. Miroshnichenko, Yu. A. Lebedev, S. A. Shevelev, V. I. Guleuskaya, and A. A. Fainzilberb 16 May 1968 9 p refs Transl. into ENGLISH from Zh. Fiz. Khim. (Moscow), v. 41, no. 6, 1967 p 1477-1479
(TRANS-2605; AD-669988)

The heats of combustion of solid and liquid trinitromethane were determined in a polymicrocalorimeter, these amounting to 792.2 plus or minus 3.2 and 816.5 plus or minus 2.8 cal/gram, respectively. From this have been calculated the enthalpy of formation of solid nitroform at standard conditions as being -11.5 plus or minus 0.5 kcal/mole, and for the liquid phase -7.9 plus or minus 0.4 kcal/mole. From the relationship of the pressures of the saturated vapor over solid and over liquid trinitromethane the heat of sublimation was calculated as being 11.0 plus or minus 0.1 kcal/mole, and the heat of fusion as being 7.8 plus or minus 0.1 kcal/mole. The energy of dissociation of the C-H bond in trinitromethane was determined to be 100.5 plus or minus 3 kcal/mole. Author (TAB)

N68-30568# Mound Lab., Miamisburg, Ohio.
THE EXCHANGE OF ISOTOPICALLY ENRICHED OXYGEN WITH PLUTONIUM $^{238}PuO_2$ SOL-GEL MICROSPHERES
D. L. Plymale 1 May 1968 8 p refs
(Contract AT(33-1)-GEN-53)
(MLM-1462) CFSTI: HC$3.00/MF$0.65

An exchange reaction between $^{238}PuO_2$ sol-gel microspheres and oxygen enriched in ^{18}O was performed at two temperatures, 700 and 850°C. A slower exchange rate was observed at 850°C

and was thought to be due to the sintering of the microspheres. A neutron reduction, characteristic of an equilibrium condition, was observed at both temperatures; however, the spheres possessed a high neutron emission, probably due to light element impurities. An exchange reaction at 700°C coupled with sintering at 1200°C for several hours reduced the emission to the predicted value of 5.0×10^3 n/sec-g. Author (NSA)

N68-30582*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
LOW-ENERGY ELECTRON DIFFRACTION STUDY OF OXYGEN ADSORPTION ON MOLYBDENUM (111) SURFACE
John Ferrante and Gilbert C. Barton Washington Aug. 1968 19 p refs
(NASA-TN-D-4735) CFSTI: HC$3.00/MF$0.65 CSCL 07D

Low energy electron diffraction was used to study oxygen absorption on, and thermal stability of, the Mo (111) surface. The crystal was subjected to oxygen exposures ranging from 0 to 10^{-4} torr-sec. The oxygen exposures resulted in four new surface structures, a chemisorbed structure and three others identified as chemical faceting into (112) planes. The latter required heating the crystal to 700°C to form completely. Differences from oxygen adsorption on W (111) were observed. Oxidation of the surface at room temperature was demonstrated. The surface was found to be thermally stable when heated for several minutes at 2100°C. Author

N68-30591# Bhabha Atomic Research Centre, Bombay (India). Chemistry Div.
STUDIES ON THE PREPARATION OF HIGH PURITY INDIUM
Radha R. Das and T. R. Bhat 1967 17 p refs
(BARC-324) CFSTI: HC$3.00/MF$0.65

A method has been developed for the large laboratory scale preparation of indium starting with the commercial metal of 99% purity. The method consists of the purification of the metal chloride by either ion exchange or solvent extraction, followed by its electrolysis to get the pure metal. The optimum conditions for each step have been established. The final product was found to be 99.995% pure indium. Author

N68-30603*# Scripta Technica, Inc., Washington, D. C.
SUPPLEMENT TO OUR COMMUNICATION ON FORMALDEHYDE AND FORMATE FORMATION [NACHTRAG ZU UNSERER MITTHEILUNG UEBER FORMALDEHYD UND FORMIATBILDUNG]
H. Euler and A. Euler NASA Jul. 1968 13 p refs Transl. into ENGLISH from Ber. Deut. Chem. Ges. (Berlin), v. 39, 1906 p 36-51
(Contract NASw-1694)
(NASA-TT-F-11709) CFSTI: HC$3.00/MF$0.65 CSCL 07C

Three separate papers are presented, dealing respectively with the condition under which formaldehyde is converted to formate by bases, the formation of sugar from formaldehyde, and the formation of i-arabinoketose from formaldehyde. Author

N68-30619# Japan Atomic Energy Research Inst., Tokyo.
EFFECT OF ADDITIVES ON THE RADIATION-INDUCED POLYMERIZATION OF TRIOXANE
Tsutomu Naruse, Mikio Haga, Kenji Fueki, and Zen-ichiro Kuri (Nagoya Univ., Japan) Mar. 1968 12 p refs Transl. into ENGLISH from J. Chem. Soc. Japan, Ind. Chem. Sect. (Tokyo), v. 69, no. 3, Mar. 1966 p 527-530
(NSJ-TR-108) CFSTI: HC$3.00/MF$0.65

Effects of additives known as electron or proton acceptors were investigated, since an ionic polymerization process was considered to take part in the radiation-induced solid-state polymerization of trioxane. The rate of polymerization increased in the presence of electron acceptors and decreased markedly in the presence of proton acceptors. These results indicate the participation of a cationic mechanism. The free ion yield (G_{f_x}) in trioxane was estimated to be about 1.3, applying the Mayo-Overberger relation to the results obtained in the presence of ammonia. Author

N68-30659
INVESTIGATION OF SOME PROPERTIES OF PRUSSTITE (Ag_3 AsS_3)
M. I. Butsko, E. G. Moroz, and I. S. Osypishin [1968] 3 p refs Transl. into ENGLISH from Ukr. Fiz. Zh. (Kiev), v. 12, no. 12, 1967 p 2052-2054
CFSTI: HC$3.00/MF$0.65

Physical, photoelectric, and optical properties of fabricated prusstite (Ag_3AsS_3) samples are discussed. S.C.W.

N68-30674# Los Alamos Scientific Lab., N. Mex.
SHOCK WAVE COMPRESSION OF BENZENE, CARBON DISULFIDE, CARBON TETRACHLORIDE, AND LIQUID NITROGEN
Richard Dean Dick (Ph.D. Thesis—Arizona State Univ.) 30 Apr. 1968 103 p refs
(Contract W-7405-ENG-36)
(LA-3915) CFSTI: HC$3.00/MF$0.65

Shock waves generated by high explosives were used to obtain Hugoniot data for benzene, carbon disulfide, and carbon tetrachloride initially at 300°K and liquid nitrogen initially at 75°K. Electrical pin contactors were used to determine the shock velocity in a dural standard plate and in the liquids. From these data and the known dural equation of state, the Hugoniot curves for the liquids were determined by means of the conservation relations and continuity conditions. Dynamic pressures achieved ranged from 20 to 600 kbar in the samples. A plot of the shock velocity (U_s) versus particle velocity (U_p) data for benzene revealed three regions each of which is described by a linear relationship. This is indicative of a transition occurring at 125 kbar and ending at 180 kbar. The carbon disulfide U_s-U_p plot reveals a lower region fitted by a straight line, a middle region of constant shock velocity, and an upper region fitted by another straight line. The middle portion corresponds to 64 kbar and the liquid is believed to transform at this pressure to the so-called black form of carbon disulfide. Author (NSA)

N68-30711# Brookhaven National Lab., Upton, N. Y. Dept. of Chemistry.
CURRENT PROBLEMS IN THE CHEMICAL EFFECTS OF NUCLEAR TRANSFORMATIONS
Garman Harbottle [1968] 23 p refs Presented at the IANEC 2d Inter-Am. Conf. on Radiochem. Mexico City, 22-25 Apr. 1968
(BNL-12361; CONF-680423-2) CFSTI: HC$3.00/MF$0.65

Research in hot-atom chemistry is reviewed and some suggested that can be attacked in radiochemistry laboratories having limited facilities. Topics covered include: chemical effects of isomeric decay in liquid organic halides and comparison with the (n,γ) reaction, mechanisms governing the recoil chemistry of hot atoms in complex ion crystals, specific problems in annealing reactions of recoil atoms in crystals, dilute solution studies, noble gas chemistry in recoil reactions, and hot atom effects in nature with natural radioactive isotopes. NSA

N68-30724# Panametrics, Inc., Waltham, Mass.
EXPERIMENTAL DETERMINATION OF GAS PROPERTIES AT HIGH TEMPERATURES AND/OR PRESSURES

E. H. Carnevale, C. Carey, T. Marshall, and S. Uva Arnold AF Sta., Tenn. Arnold Eng. Develop. Center Jun. 1968 121 p refs
(Contract AF 40(600)-1191)
(AEDC-TR-68-105; AD-670192)

The available viscosity and thermal conductivity data in helium, argon, hydrogen, and nitrogen are reviewed. Deviation charts vs temperature are drawn up for each of the gases of interest in the temperature range 200-2500K. High temperature thermal conductivity measurements in air, argon and nitrogen are also reviewed at temperatures between 2000 and 12,000K. The methods of measuring thermal conductivity and viscosity are discussed with emphasis on the extension of available techniques to higher temperatures and/or pressures. Major emphasis is placed on constricted arc, heat transfer, schlieren, and ultrasonic techniques. Finally, measurements of helium thermal conductivity in the temperature range approx. 400-3000K by the ultrasonic technique in the shock tube are presented. Author (TAB)

N68-30742# Washington Univ., St. Louis, Mo. Dept. of Physics.
RELAXATION AND MOTION IN SIMPLE SYSTEMS Final Scientific Report
R. E. Norberg 14 May 1968 9 p refs
(Grant AF-AFOSR-1119-66)
(AFOSR-68-1154; AD-670175)

A series of pulsed NMR investigations were accomplished on simple systems. The principal objective of the program is the study of internal motions in liquid and solid neon and krypton. In addition, similar experiments were carried out on selected ionic crystals and semiconducting compounds. Author (TAB)

N68-30779# Polish Academy of Sciences, Cracow.
INVESTIGATION OF WATER MOLECULES DYNAMICS IN CRYSTALLO-HYDRATES BY INELASTIC NEUTRON SCATTERING [BADANIE DYNAMIKI DROBIN WODY W HYDRATACH KRYSTALICZNYCH PRZY POMOCY NIESPREZYSTEGO ROZPRASZANIA NEUTRONOW]
A. Bajorek (Jagellonian Univ.), J. A. Janik, J. M. Janik (Jagellonian Univ.), I. Natkaniec, K. Parlinski et al 1968 35 p refs Prepared jointly with Joint Inst. for Nucl. Res.
(INP-601/P) CFSTI: HC$3.00/MF$0.65

The following compounds were studied: ice, $Li_2SO_4 \cdot H_2O$, $LiClO_4 \cdot 3H_2O$, $NiSo_4 \cdot 7H_2O$, $NiSo_4 \cdot 6H_2O$, $LiCl \cdot H_2O$, and $La_2Mg_3(NO_3)_{12} \cdot 24H_2O$. In these compounds the configurations of water molecules as well as types of hydrogen bonds differ in significant respects, and it may be expected that these differences will be reflected in the spectra. Data are presented on the structure of the substances and on the experimental method applied. The results are compared with other data and also with those obtained by infrared technique. Author

N68-30794# United Kingdom Atomic Energy Authority, Windscale (England). Production Group.
THE DETERMINATION OF PLUTONIUM BY AMPEROMETRIC TITRATION (ARGENTIC OXIDATION, FERROUS REDUCTION)
J. Cherry, J. Holmes, and J. J. B. Williams 1968 12 p
(PG-832(W)) CFSTI: HC$3.00/MF$0.65

The plutonium, in dilute sulphuric acid solution, is oxidized to plutonium (VI) with silver (II) oxide; excess of the oxidant is then destroyed with sulphamic acid. Plutonium (VI) is reduced to plutonium (IV) by adding a slight excess of a standard solution of iron (II). The excess is determined by titrating with a standard solution of potassium dichromate. The end points for reduction with iron (II) and oxidation with dichromate are obtained amperometrically with two platinum electrodes. Author

N68-30818# Michigan Univ., Ann Arbor. Infrared Physics Lab.
TOTAL RADIANCES AND EQUIVALENT WIDTHS OF ISOLATED SPECTRAL LINES WITH COMBINED DOPPLER AND COLLISION-BROADENED PROFILES
H. Y. Yamada Oct. 1967 33 p refs
(Contract DAHC15-67-C-0062)
(Rept.-8416-17-T; AD-670022)

Analytical expressions for total radiances (NV) and equivalent widths (WV) of isolated spectral lines with combined Doppler and collision-broadened profiles are presented for isothermal paths. It is shown that the curves of growth for $0 < a < 0.5$, where $a/(\ln 2)$ to the 1/2 power is the ratio of the Lorentz to the Doppler line half-width, can be divided into three regions, depending on optical depth: purely Doppler, purely Lorentz, and a transition region between the two for which explicit expressions are given. For $a = 0$, only Doppler broadening is effective and the curve of growth is purely Doppler, irrespective of optical depth. For $a > or = 0.5$, the curves of growth are shown to be equivalent to purely Lorentz, irrespective of optical depth. Author (TAB)

N68-30827*# Techtran Corp., Glen Burnie, Md.
APPLICATION OF MICROWAVE SPECTROMETRY FOR THE DETERMINATION OF ETHYL AND ISOPROPYL ALCOHOL IMPURITIES IN GASOLINE [PRIMENENIYE MIKROVOLNOVOY SPEKTROMETRII DLYA OPREDELENIYA PRIMESEY ETILOVOGO I IZOPROPILOVOGO SPIRTOV V BENZINE]
A. N. Aleksandrov and G. I. Tysovskiy Washington NASA Jul. 1968 6 p refs Transl. into ENGLISH from Zh. Analit. Khim. (USSR), v. 22, no. 10, 1967 p 1532–1535
(Contract NASw-1695)
(NASA-TT-F-11855) CFSTI: $3.00 CSCL 07D

A wide band microwave spectrometer designed for analytical studies is described, and a quantitative method for determining ethyl and isopropyl alcohol impurities in gasoline is developed. The proposed spectrometer incorporates UHF tubes with crossed fields as the emission source and permits measurement of relative intensities in the 7,000 MHz band and higher. This apparatus can be used for the quantitative and qualitative analysis of multicomponent organic mixtures and has advantages over methods such as IR-spectroscopy and chromatography. The analytical results are summarized in tables for ethyl and isopropyl alcohol in gasoline. Author

N68-30829*# National Aeronautics and Space Administration, Washington, D. C.
EXOTHERMIC PROCESS IN THE DIFFERENTIAL THERMAL ANALYSIS CURVE OF BASIC MAGNESIUM CARBONATE
H. Hashimoto, Toshiaki Tomizawa, and Mamoru Mitomo Jul. 1968 14 p refs Transl. into ENGLISH from Kogyo Kagaku Zasshi (Tokyo), v. 71, no. 4, 1968 p 480–484
(NASA-TT-F-11858) CFSTI: HC$3.00/MF$0.65 CSCL 07B

It is known that the differential thermal analysis (DTA) curve of basic magnesium carbonate exhibits an exothermic process. It was found in this study that this exothermic process was greatly affected by the atmosphere in which the decomposition reaction was carried out. This exothermic process and its cause were followed by DTA, thermogravimetric analysis (TGA), X-ray diffraction, and chemical analyses. When basic magnesium carbonate is heated in air or nitrogen, it loses water in the temperature range 150–350°C to become amorphous magnesium carbonate. This amorphous carbonate begins to dissociate from about 400°C to become amorphous magnesium oxide. The crystallization of this amorphous oxide starts at about 505°C, and this is the source of this exothermic process. The exothermic process is much greater when the heating is conducted in an atmosphere of carbon dioxide. On the other hand, no exothermic process was seen when the heating was conducted under reduced pressure. The occurrence of

the exothermic peak in the DTA curve and its magnitude are controlled by the ease at which CO_2 is released from within the amorphous oxide. Author

N68-30830*# Techtran Corp., Glen Burnie, Md.
POLYMORPHISM OF COPPER SULFIDES IN THE SYSTEM Cu_2S–$Cu_{1.8}S$
E. N. Yeliseyev, L. Ye Rudenko, L. A. Sinev, B. L. Koshurnikov, and N. I. Solovov Washington NASA Jul. 1968 18 p refs Transl. into ENGLISH from Mineralog. Sb. (USSR), v. 18, no. 4, 1964 p 385–400
(Contract NASw-1695)
(NASA-TT-F-11766) CFSTI: HC $3.00/MF $0.65 CSCL 07D

Four mineral species have been determined in the system Cu_2S–$Cu_{1.8}S$. They are chalcosine Cu_2S, djurlite $Cu_{1.96}S$, a new hexagonal copper sulfide $Cu_{1.9}S$, and digenite $Cu_{1.8}S$. A precise diagnosis of the phases and their polymorphic modifications of copper sulfides may serve as an important criterion of physical-chemical conditions of the crystallization of native minerals in ores and chemical combinations in products of metallurgical alteration of copper sulfide and copper-nickel ores. The native copper sulfides of one or another composition originate as a result of oxidizing conditions in mineral formations. The data on copper sulfides, both minerals and artificial compounds in the system Cu_2S–$Cu_{1.96}S$ quoted in the paper may be considered standard. Author

N68-30841# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions.
ELEMENT 103 OF THE PERIODIC SYSTEM [103-I ELEMENT PERIODICHESKOI SISTEMY]
E. D. Donets, V. A. Druin, and V. L. Mikheev 1968 22 p refs In RUSSIAN Submitted for publication
(JINR-P7-3766)

Results of work on the synthesis and studies of the properties of Element 103 isotopes are analyzed. It was concluded that the most reliable and complete data were obtained for the isotope $^{256}103$. The half-life of this isotope is about 35 sec and its alpha emission spectrum is complicated and lies between 8.3 and 8.5 MeV. To get the same degree of unambiguity in determining the properties of other isotopes of element 103, in particular of $^{257}103$, some additional experiments are needed. Author (NSA)

N68-30855*# National Aeronautics and Space Administration, Washington, D. C.
ON THE RELATIONSHIP BETWEEN MOLECULAR STRUCTURE OF POLYVINYL CHLORIDE AND ITS THERMAL DECOMPOSITION PRODUCT [POLYVINYL CHLORIDE NO BUNSHI KOZO TO SHYOSEIBUTSU TONO KANKEI]
Sugiro Ohtani and Takeharu Ishikawa (Kumma Univ.) May 1968 12 p refs Transl. into ENGLISH from Chem. Soc. of Japan, v. 65, 1962 p 1617–1622
(NASA-TT-F-11733; Rept.-12) CFSTI: HC $3.00/MF $0.65 CSCL 07C

A thermal weight analysis of polyvinyl chloride was conducted and infrared and UV absorption spectra of the product obtained by heating at 425°C were observed. Polyvinyl chloride was Geon 103 EP(G) and polymerized at −30°C(F). Activation energy of both materials obtained from the initial decomposition period of thermal weight analysis curve was 22 Kcal, but for the thermal decomposition process above 400°C, G was 37 Kcal and F, 46 Kcal. Both materials were separated into several fractions by column chromatography and infrared and UV absorption spectra were investigated. The average molecular weight of decomposition products was 700–800 and these were composed of ring structure and saturated aromatic family structure. The decomposition product from G had more aromatic family structure than that of F; F seemed to have more linear type ring compounds than G. These results indicate that syndyotactic and isotactic structures in PVC play an important role in determining the structure of the decomposition product. Author

N68-30863# California Univ., San Diego.
ELECTROPHILIC ADDITIONS TO ACETYLENES Final Report
Robert C. Fahey 15 Apr. 1968 3 p refs
(Grant DA-ARO(D)-31-124-G585)
(AD-669614)

A brief summary is given of work designed to obtain information on the products, rates, stereochemistry, and kinetics of electrophilic additions to acetylenes (especially halogen and hydrogen halide additions) which would clarify the scope and mechanism of these reactions. TAB

07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N68-29571 Polytechnic Inst. of Brooklyn, N. Y.
NON-UNIFORMLY SPACED ANTENNA ARRAYS
Samuel Lung Shih (Ph.D. Thesis) 1967 176 p
Available from Univ. Microfilms: HC $8.20/MF $3.00 Order No. 67-10956

New methods are developed for the optimization and synthesis of antenna arrays. The first part deals with the problem of optimizing the performance of an array in terms of sidelobe, gain and supergain ratio. For the reduction of the sidelobes, a new method is developed by which the phase shifts of the elements required for the minimum sidelobe level are determined in one step. For the optimization of the gain, it is proposed to adjust both the excitation and the spacing of the elements. The determination of the optimum excitation, spacing and gain is shown to be an eigenvalue problem and is carried out on a digital computer using the difference calculus and the Newton-Raphson method. For the minimization of the supergain ratio, it is shown that this can also be reduced to an eigenvalue problem. In the synthesis part, orthogonal functions are used to synthesize an array to radiate a prescribed pattern. Another new synthesis method is developed using the Lambda function which is not an orthogonal set. The space factor of an array and a prescribed radiation pattern can be reduced into the same form in terms of the Lambda function. By equating the coefficients of the Lambda function, the element excitation can be determined directly. Dissert. Abstr.

N68-29597# Royal Aircraft Establishment, Farnborough (England).
THE RELATIVE PHASE STABILITY OF COAXIAL CABLES AT V.H.F.
D. F. France Oct. 1966 13 p refs
(RAE-TR-66323) CFSTI: HC $3.00/MF $0.65

The relative phase-stability of coaxial cables is of paramount importance in radio-interferometer installations. Experimental results on several different types of coaxial cable under different environmental conditions are given. Recommendations are made for the installation of such cables when carrying interferometer signals at V.H.F. Author

N68-29722# Navy Underwater Sound Reference Lab., Orlando, Fla.
APPLICATION OF THE NEAR-FIELD-ARRAY TECHNIQUE TO SONAR EVALUATION
W. James Trott and Ivor D. Groves 20 May 1968 33 p refs
(NRL-6734; AD-669433)

The design, construction, and step-by-step tests of the near-field array as developed at this laboratory are described. The optimum design and design tolerances for several arrays have been found by means of a digital computer. A guide for estimating the cost of an array for application to a particular sonar evaluation is derived from experience in the construction of these new arrays. Author (TAB)

N68-29741# Royal Aircraft Establishment, Farnborough (England).
THE POWER DENSITY SPECTRA OF CERTAIN FREQUENCY MODULATED WAVES
R. G. Hollingworth Apr. 1967 44 p refs
(PAE-TR-67079) CFSTI: HC $3.00/MF $0.65

The application of correlation methods in the determination of the distribution of energy with frequency in a frequency modulated wave is described. Series expressions are derived for the power density spectrum of such a wave when the modulation is (1) a Gaussian random process and (2) a Gaussian random process with the addition of a sine wave. The usefulness of Woodward's theorem, when the modulation is such as to cause large instantaneous frequency deviations of the carrier, is demonstrated. The significance of these results is discussed in relation to the design of a wide band microwave noise source. It is shown that if an existing random noise modulation waveform is supplemented by the addition of a low frequency sine wave modulation waveform of mean square value comparable to that of the noise, then the frequency spectrum of the resultant modulated wave is substantially wider than that produced by the noise modulation alone. Author

N68-29744# Navy Electronics Lab., San Diego, Calif. Center for Command Control and Communications.
RADIO PROPAGATION OVER THE SEA IN THE 2-TO-10-MHZ RANGE Research Report, Jul. 1966-Jan. 1967
C. H. Freres, D. B. Sailors, and T. L. Taylor 21 Nov. 1967 83 p refs
(NELC-1526; AD-669442)

Computer model studies reveal effects of sky wave and noise on the ground wave. Sky-wave interference is greater for low sunspot number, for low F-layer height, and in winter. For 1-kW radiated power at night, the sky-wave field strength of the one-hop F2 mode at 3 MHz is equal to the ground-wave field strength at a range of 340 km. When vertically polarized antennas with a sq cos delta pattern are used, the ground-wave signal strength is 20 dB above the sky-wave signal strength at a range of 340 km. The detectability of signals within the 2-to-10-MHz band at long range by sky-wave modes is also given. Author (TAB)

N68-29751# California Inst. of Tech., Pasadena. Antenna Lab.
RADIATION OF A HERTZ DIPOLE MOVING AROUND A CONDUCTING SPHERE
John Lam Mar. 1968 41 p refs
(Grant AF-AFOSR-68-1400)
(TR-43; AD-669370)

An exact expression is obtained for the field of a horizontal Hertz dipole moving around a conducting sphere in a circular orbit. This expression is in the form of a double series which, in the case of a large sphere, is evaluated by the method of Watson transformation. The geometrical optics field is separated out and its properties examined. It is found that the incident and reflected waves are of different frequencies. Author (TAB)

N68-29768 Colorado Univ., Boulder.
AN INVESTIGATION OF REAL IMAGE DISPLAY SPATIAL FILTERING BY MEANS OF HOLOGRAMS
Cecil Leon Hayes (Ph.D. Thesis) 1966 48 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-10049

Methods of detecting a desired optical signal have been recently documented. One factor missing is the process of displaying that signal in its orginal form after detection. The spatial filtering technique described here provides such a scheme for a real image display. This has been investigated by making use of holographic techniques to synthesize a desired complex filter function. In most general terms, the filter is given by $S_{desired}/S_{input}$ where the input signal may contain noise or unwanted information. Holography provides the means of realization for such possible complex quantities. Use is made of the Fourier transforming character of lenses to achieve separation of sixteen information bearing signals that arise in the synthesis. The end result is a spatially oriented display in which the desired signal has retained its form and positional information. Dissert. Abstr.

N68-29774# Rome Air Development Center, Griffiss AFB, N. Y.
AN/GPA-123 SUM AND DIFFERENCE ANTENNA GROUP
Frank T. Benvenga Apr. 1968 52 p
(RADC-TR-68-140; AD-669386)

Prior to this development Interrogation Side Lobe Suppression (ISLS) was accomplished with the use of two separate antennas: a directional and an omnidirectional antenna. The same results, however, can be achieved through the use of a single directional antenna which can produce two distinct patterns. The sum and difference patterns are obtained by feeding the antenna in two halves by means of a hybrid junction. This system also has an additional benefit of effectively sharpening the beamwidth when interrogating ISLS equipped airborne transponders. A trade-off is necessary, however, in that the one antenna system is more complex and requires a greater degree of precision. Operational tests conducted indicate that the development effort was successful and ISLS is possible using this system. Requirements of the specification and design objectives were for the most part achieved. Author (TAB)

N68-29785 Syracuse Univ., N. Y.
THE INFLUENCE OF LARGE PLANAR AND CYLINDRICAL SEGMENT GROUND SCREENS ON THE VERTICAL FIELD STRENGTH
Lloyd Oscar Krause (Ph.D. Thesis) 1966 154 p
Available from Univ. Microfilms: HC $7.20/MF $3.00 Order No. 67-7060

A formulation based on scattering techniques is developed. The ground screen is viewed as a scatterer in free-space, excited by a plane wave. A Fresnel image-wave is added to establish the air-earth interface. The desired field is then the sum of the two incident fields and their scattered fields. Formulations are developed for the semi-infinite screen and for the circular-cylinder surface segment screen. The semi-infinite screen is representative in performance to a round screen of radius equal to the distance from the edge of the semi-infinite screen at which the field is computed or measured. Results for the field normal to the screen are given for positions between 3–100λ from its edge. The screen has several tilt angles and heights, and the field is given for several distances above the screen, and for several earth characteristics. Dissert. Abstr.

N68-29822 Arizona State Univ., Tempe.
FOURIER METHODS IN OPTICAL SIGNAL PROCESSING FOR RADAR APPLICATIONS

Howard R. Mc Quillen (Ph.D. Thesis) 1967 126 p
Available from Univ. Microfilms: HC $6.20/MF $3.00 Order No. 67-12650

This report describes the study to evolve mathematical models useful to analyses in coherent optical data processing, especially applied to terrain-imaging radar. The purpose is to develop from basic optical theory the light disturbance descriptions resulting from the principal operations in processing systems. These operations are then combined into general operations which can be used to determine disturbances of subsystems. The coherent light disturbance is treated as a scalar and considered a component of the electromagnetic field. Analytic signal description is used, and properties of this description are especially derived for best advantage in the study. Beginning with the spatial frequency spectrum of a coherent disturbance over a plane, and using the scalar wave equation, it is shown that the intervening space to another parallel plane acts, in general, exactly like a two-dimensional dispersive filter. Detailed descriptions and practical approximations of the filter are evolved. One basic diffraction element, the thin lens model, is shown to be space variant. Dissert. Abstr.

N68-29825# Stanford Research Inst., Menlo Park, Calif.
UNUSUAL COMMUNICATIONS TECHNIQUES Final Report
Elmer Baum and Albert J. Mandelbaum Feb. 1968 74 p refs
(Contract OCD-PS-64-201(70))
(AD-669635)

A review and evaluation is made of unusual communications techniques and unusual applications of conventional communications techniques for civil defense purposes, to identify those that offer the best potential for supporting civil defense requirements. Included in the report are general civil defense operational communications requirements at the federal, state, and local levels, as well as the operational parameters and criteria for evaluating the technical feasibility of candidate techniques. The estimated duration, effort, and funding for the practical development of the recommended techniques are given. Author (TAB)

N68-29830# Army Engineer Waterways Experiment Station, Vicksburg, Miss.
STRUCTURE AND FOUNDATION BEHAVIOR DURING ANTENNA OPERATION, TAA-ZA VERO BEACH, FLORIDA, AND TAA-3 MERRITT ISLAND, FLORIDA Final Report
Jack Fowler and Roy E. Leach Mar. 1968 69 p *Its* Misc. Papers No. 4-983
(AD-669239)

The report describes a study conducted to determine the motion of the structure and foundation during antenna operation for the: (a) TAA-2s radar tower, Vero Beach, Florida, and (b) TAA-3 antenna, Merritt Island, Florida. Specifically, these tests determined the magnitude and direction of displacement, natural frequencies, phase of movement, and attenuation characteristics of the structure and foundation. These tests were performed using maximum programmed antenna accelerations, velocities, and decelerations, which were recorded for correlations. Motion in three planes—vertical, radial, and tangential—was monitored at different transducer locations by means of velocity-type pickups. Theoretical procedures described in EM 1110-345-310 were used to predict the frequencies and displacements that would occur. Author (TAB)

N68-29839# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.
INERTIALESS POLARIZATION SCANNERS Final Technical Report, 14 Feb.–30 Sep. 1967
M. E. Wallace, G. W. Ewell, and L. A. Stapleton Apr. 1968 60 p refs
(Contract DAAH01-67-C-1438)
(AD-669670)

The report discusses the principles of operation, the design, and the performance of a pair of X-band polarization-agile radar antennas, one for transmitting and one for receiving. These antennas are compatible with an existing pulse-Doppler radar and utilize front-fed 4-foot paraboloidal reflectors. The direction of linear polarization of these antennas can be rotated in digital increments on a pulse-to-pulse basis at prfs as high as 50 KHz. An electronic programmer permits the manual selection of any one of 32 polarization directions or the automatic sequencing of the available polarization directions in a variety of operational modes. A change in polarization is accomplished in less than two microseconds and the total insertion loss of each complete antenna is less than 1.0 dB. The antennas track within 7 degrees for all polarization directions with polarization purity greater than 23 dB for frequencies between 9.8 and 10.25 GHz. The gain, VSWR, and antenna patterns of the polarization-agile antennas are comparable to single-polarization antennas of the same size. Author (TAB)

N68-29856*# Hughes Aircraft Co., Culver City, Calif. Aerospace Group.
USER'S MANUAL FOR COPTRAN, A METHOD OF OPTIMUM COMMUNICATION SYSTEM DESIGN
L. S. Stokes, K. L. Brinkman, and W. K. Pratt Jun. 1968 165 p
(Contract NAS12-566)
(NASA-CR-86080: P68-134, Rev. 1) CFSTI: HC $3.00/MF $0.65
CSCL 17B

Reported is a user's manual for the COPTRAN programming language which is a specialized, simple computer language used in the design of communication systems. COPTRAN allows a user to determine the optimum configuration of a communication system with relatively few instructions phrased in the context of his problem and without the necessity of supplying large quantities of data to the computer. This is accomplished by storing nominal values of the program data in the computer data banks. The pertinent data for a particular problem is then automatically fetched by the COPTRAN program unless countermanded by particular user selections. Contents of the manual include data on the COPTRAN programming structure; COPTRAN use; examples of COPTRAN use; the library of nominal system burdens data for the COPTRAN program; automatic COPTRAN burden data selection logic; and COPTRAN coding sheets and data forms. S.C.W.

N68-29860 Syracuse Univ., N. Y.
ADAPTIVE SIGNAL DESIGN AND PROCESSING FOR AN ACTIVE SONAR SYSTEM
James Gregory Rudolph (Ph.D. Thesis) 1967 144 p
Available from Univ. Microfilms: HC $6.80/MF $3.00 Order No. 67-12078

Statistical detection theory is applied to an active sonar system where, together with an array receiver, space-time signal and noise fields are considered. For Gaussian noise fields, which are not required to be stationary, the likelihood ratio is formed, and a test statistic that is dependent on the array receiver structure is specified. A signal-to-noise ratio is then defined in terms of the test statistic and is shown to be maximum for the receiving function which is defined by an integral equation. The signal-to-noise ratio is shown to be less than maximum for any other receiving function. Computational verification of the theory is obtained for both single-element and array receivers where the autocorrelation function matrix of the noise has elements of exponential form and the signal and receiving functions are expanded in trigonometric Fourier series. System performance is determined for correlated and uncorrelated noise fields and comparisons are made between optimum systems and suboptimum systems for the same noise field. The limitations of each are then discussed. Dissert. Abstr.

N68-29885 Polytechnic Inst. of Brooklyn, Farmingdale, N. Y.
RECORDING AND DISPLAY OF REDUCED-BANDWIDTH TV SIGNALS
Philip Balaban (Ph.D. Thesis) 1967 129 p
Available from Univ. Microfilms: HC $6.20/MF $3.00 Order No. 67-10951

The properties of bandwidth reduction using random scan are discussed and the generations of such scans is evaluated. The effect of different disturbances such as low-pass filtering, burst noise, ghosts etc., encountered in a transmission channel are evaluated and compared to the effect on conventionally scanned signals. A system is described that was developed in order to record the pseudo-random scanned television signal. The objective was to investigate the possibility of recording a 200 kHz video signal on a 1/4 inch tape running at 15 inch/sec. The difficulties which arise in such a task are two-fold: a) bandwidth limitations of the recorder; b) flutter and skew of the recorder. Bandwidth reduction for extremely slow frame rates is evaluated experimentally. A scan conversion apparatus was built to provide the necessary long storage of the image. An experiment using a frame of one per seventeen seconds is discussed. Dissert. Abstr.

N68-29971# Army Electronics Labs., Fort Monmouth, N. J.
TRANSMISSION LOSSES IN A FOREST FOR ANTENNAS CLOSE TO THE GROUND
David F. Dence and Theodore Tamir (Polytech. Inst. of Brooklyn, N. Y.) Feb. 1968 40 p refs Prepared in cooperation with Duke Univ. Consultant Serv.
(Contract DA-31-124-ARO(D)-399; ARPA Order 371)
(ECOM-2940; AD-669608)

During the last few years, measurements have been made to determine the electrical characteristics and the predominant mode of propagation in a forest environment. This work was essential because of the severe attenuation of radio communication signals which occur when operating in a forest medium. Theoretical investigations have shown that for distances greater than 1 km and for frequencies between 2 and 200 MHz the forest can be represented to a first approximation as a conductive slab bounded on one side by air and on the other side by the earth. Using this conductive slab as a model, the transmission losses between two elementary dipoles located close to the ground in a forest were calculated for both horizontal and vertical polarization. Those parameters which would affect the transmission losses are examined and then the sensitivity of the respective parameters is evaluated in detail. It turns out that the change in input resistance caused by the ground proximity produces a loss which may be considerably larger than the other losses. Various data are presented which show the theoretical transmission losses vs frequency for different parameters which include the height of the antenna above ground, the height of the forest, and the electrical characteristics of the ground and the forest. Author (TAB)

N68-30003*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MEASUREMENTS IN THE IONOSPHERE OF THE ASPECT DEPENDENCE OF ANTENNA REACTANCE. PART 1: VARIATIONS ARISING FROM THE INHOMOGENEOUS PLASMA DISTRIBUTION ABOUT THE VEHICLE
Robert G. Stone, Joseph Fainberg, and J. K. Alexander Jul. 1968 25 p refs
(NASA-TM-X-63285; X-615-68-261) CFSTI: HC $3.00/MF $0.65 CSCL 22C

Measurements of antenna reactance from a sounding rocket traveling through the ionosphere show variations related to the rocket spin period. The observed variations can be resolved into components with periodic time structure equal to the spin period, half the spin period, or a mixture of these. The relative importance of these components depends on the experiment configuration and the flight trajectory as well as on the magnetoionic parameters. To account for the observations, it is necessary to take into consideration the response of an antenna to the magnetoionic medium and to the disturbance produced in the ambient plasma by the rocket motion. Examples of the plasma distribution about the rocket, as inferred from the antenna reactance measurements, are shown and discussed. Author

N68-30039*# Hughes Aircraft Co., Culver City, Calif. Aerospace Group.
STUDY AND DEVELOPMENT OF A MATHEMATICAL ANALYSIS FOR THE PERFORMANCE ASSESSMENT OF SPACE COMMUNICATION SYSTEM PARAMETERS
L. S. Stokes, K. L. Brinkman, and W. K. Pratt Cambridge, Mass. NASA. Electron Res. Center Mar. 1968 184 p
(Contract NAS12-566)
(NASA-CR-86081; P68-06) CFSTI: HC $3.00/MF $0.65 CSCL 17B

A user's manual is presented on COPTRAN, a method of optimum space communication system design using an electronic computer. Written in an interpretative computer language, COPTRAN programming is designed to enable a user who is not familiar with computer operation to instruct the computer to solve a communication problem. The program language and examples of usage are given. A library of nominal data decks is listed, and the program logic to automatically select the data is documented. Interface equipment for more rapid future utilization of the system is proposed along with possible system configurations which could be available for remote stations. D.H.B.

N68-30083# Rome Air Development Center, Griffiss AFB, N. Y.
ANALYSIS AND MEASUREMENT OF A CIRCULAR TRANSMISSION LINE ANTENNA
John Nelson Entziminger, Jr. (M.S. Thesis—Syracuse Univ.) May 1968 111 p refs
(RADC-TR-68-85; AD-670163)

Experimental data and results of mathematical analysis are presented for determining the characteristics of an electrically short, circular transmission line (ring) antenna. Bandwidth-efficiency product is used as a figure of merit for comparison of the ring antenna with other types of antennas and examples of the bandwidth-efficiency product of a monopole, disk top-loaded monopole, umbrella top-loaded monopole and transmission line top-loaded monopole are given. The ring antenna is shown to have the same performance as a straight, quarter-wavelength long, shunt-driven, transmission line with a shorted termination. Author (TAB)

N68-30119# Mitre Corp., Bedford, Mass.
THE IMPROVEMENT OF DIGITAL HF COMMUNICATION THROUGH CODING
K. Brayer May 1968 82 p refs
(Contract AF 19(628)-5165)
(MTP-75; ESD-TR-68-128; AD-670184)

In previous papers the technique of error correction of digital data through the use of interleaved cyclic codes and a set of probability functions for the evaluation of error patterns have been presented. In this paper the previous results are extended to a wide range of BCH and symbol codes. A set of simple equations is presented for the description of an interleaved cyclic code and its associated delay, and a method is presented which allows for a significant increase in error rate improvement at a reduction in the delay time introduced into the channel. It is demonstrated that the performance of interleaved cyclic codes is sufficient to correct all types of measured HF error patterns; that, using delay as a basis of comparison, only the total bit interleaving is important in

achieving error correction; and that it is possible to get almost 100 percent error correction for delays under 3 seconds for all channel conditions measured. Author (TAB)

N68-30141# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
FUNDAMENTALS OF DATA TRANSMISSION VIA WIRE COMMUNICATIONS CHANNELS
V. S. Gurov, G. A. Yemel'yanov, N. N. Yetrukhin, and Ye. V. Basilevich 17 Nov. 1967 410 p refs Transl. into ENGLISH of the book "Osnovy Peredachi Dannykh Poprovodnym Kanalam Svyazi" Moscow, Izd. Svyaz', 1964 p 1-311
(FTD-HT-23-811-67; AD-669304)

This book is a textbook for students at electrical-engineering communications institutes. It may be of use also to engineers and technicians specializing in the field of data transmission. The fundamentals of the theory of transmitting pulsed signals along communications channels, the fundamentals of protecting the coding of transmitted information against interference, and information concerning the construction of data-transmission channels and circuits are presented. Author (TAB)

N68-30234#
SOME RESULTS ON MEASURING THE RADIO EMISSION INTENSITY AT A 1.68 MHz FREQUENCY FROM DATA ON THE "COSMOS-142"
A. N. Burenin, G. G. Getmantsev, N. A. Mitiakov, V. O. Rapoport, A. M. Siz'min et al [1968] 4 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 6, no. 2, 1968 p 313-315
CFSTI: HC $3.00/MF $0.65

Graphical data are presented on the intensity of received radio emission for three orbits of Cosmos-142. Graphs show that the radio emission intensity for all three orbits is similar in nature, and a number of maximums can be observed. Most characteristic are the relatively narrow and significant intense maximums corresponding to resonances at frequencies in the band between the plasma and the hybrid. The averaged history of the radio emission level was used in constructing the electron concentration profiles. Several lesser maximums on the descending portions of all three orbits which correspond to resonances at twice the gyro frequency are also noted. Dependences of the electron concentration on the satellite altitude are depicted. The change of radio emission during the ascending protion of the trajectory of the third orbit, is associated with the influence of large scale ionospheric inhomogeneities on the recorded radio emission level. B.S.D.

N68-30243 Polytechnic Inst. of Brooklyn, N. Y.
THE RESPONSE OF AN FM DISCRIMINATOR TO AN FM SIGNAL IN RANDOMLY FADING CHANNELS
Edward Alan Nelson (Ph.D. Thesis) 1967 149 p
Available from Univ. Microfilms: HC $7.00/MF $3.00 Order No. 67-10954

The response of an FM discriminator to a fading FM signal in additive Gaussian noise is obtained. The technique employed is based on the model of an FM discriminator due to Rice and extends his results of SNR (above, at, and below threshold) when demodulating an analog FM signal undergoing nonselective fading. The same model is also used for the prediction of error rates when detecting a digital FM fading signal. Dissert. Abstr.

N68-30256# Technische Hochschule Munchen (West Germany).
WAVE PROPAGATION IN HETEROGENEOUS MULTIPLE TYPE WAVE GUIDES [WELLENAUSBREITUNG IN INHOMOGENEN VIELTYP-WELLENLEITERN]
Claus Mohr 1967 22 p refs In GERMAN
CFSTI: HC $3.00/MF $0.65

Maxwell equations and conformal mapping methods are used to calculate electromagnetic wave fields and wave propagation in heterogeneous wave guides of parallel or radial geometries. A curvilinear coordinate system and surface functions are obtained for the prescribed geometric boundaries and the wave fields are determined through numerical integration of the corresponding cut-off differential equation systems. Transl. by G.G.

N68-30334# Ohio State Univ., Columbus. ElectroScience Lab.
A COMPUTER PROGRAM FOR PHYSICAL-OPTICS SCATTERING BY CONVEX CONDUCTING TARGETS
Jack H. Richmond Bedford, Mass. AFSC, Electron. Systems Div. May 1968 50 p refs
(Contract F19628-67-C20308)
(ESD-TR-68-216; AD-669815)

This report describes a digital computer program which uses the physical optics approximation to calculate the scattering properties of convex perfectly conducting targets with arbitrary shape. The target shape is described in terms of the coordinates of a large number of points on the surface. The program handles bistatic as well as backscattering problems. The input data specify the frequency, the incidence angles and the scattering angles. In the CW case, the output data give the complex elements in the scattering matrix. The program also handles the pulse case where the incident waveform has a finite number of cycles. Graphs are included to illustrate typical results for the following target shapes: sphere, spheroids, ogive, and cone. Author (TAB)

N68-30348# White Sands Missile Range, N. Mex. Atmospheric Sciences Lab.
TIMING CONTROLLED PULSE GENERATOR
James L. Johnson and Orville C. Kuberski Apr. 1968 21 p
(ECOM-5191; AD-669748)

A device was developed to generate a pulse rate using the carrier from range timing. In this case the pulse was shaped to provide a trigger to a data gathering radar. Since the same time signal is being recorded with the data, it is available for final data reduction. Author (TAB)

N68-30355 Illinois Univ., Urbana.
ERROR CORRECTING CODES FOR COMPOUND CHANNELS
Hsung Tsao Hsu (Ph.D. Thesis) 1967 101 p
Available from Univ. Microfilms: HC $5.20/MF $3.00 Order No. 67-11870

Cyclic codes of known classes today are either for burst error correction only or for random error correction only. By careful observation, a typical communication channel is disturbed by both types of errors, burst errors and random errors, but not simultaneously. By definition, a communication channel is called a compound channel if it is disturbed by both types of errors, but not simultaneously. In this thesis, an extensive study of cyclic codes as error correcting codes for compound channels was made. Decoding procedures for compound channels are briefly discussed. Many calculated numerical results are also presented. Dissert. Abstr.

N68-30363# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THEORETICAL FUNDAMENTALS OF COMMUNICATION AND CONTROL
A. A. Fel'baum and A. D. Dudykin 7 Aug. 1967 1186 p refs Transl. into ENGLISH of the book "Teoreticheskiye Osnovy Svyazi i Upravleniya" Moskva, Gosstroiizdat., 1963 p 1-932
(FTD-HT-67-191; AD-669930)

This book provides a concentrated presentation of the fundamentals of the theory of the transformation of signals by

systems. Regular and random signals, linear and nonlinear systems, and systems with and without feedback are analyzed. The presentation is illustrated by examples from the fields of radio engineering, electronics, and automation. This book can be considered as presenting only the foundation for technical cybernetics, as its limited volume prevents the inclusion of a number of important theoretical problems that have a comparatively special character or require greater preparation on the part of the student. Author (TAB)

N68-30375# Hughes Aircraft Co., Culver City, Calif. Antenna Dept.
ANTENNA PROCESSING FOR SURFACE TARGET DETECTION Scientific Report No. 1
G. O. Young Feb. 1968 122 p refs
(Contract F19628-68c-0082)
(P68-35; AFCRL-68-0119; AD-670188)

The problem of antenna processing for surface target detection in clutter is considered in this report. The general problem of the hypothesis testing and estimating of N targets in clutter and noise is formulated by means of decision theory. The theory is applied to the case of a single, nonscintillating target with unknown a priori amplitude, phase, and location. The a priori statistics of these parameters are assumed, and target detection is accomplished by means of a generalized likelihood ratio test. The hypothesis test is instrumented for clutter as well as receiver noise. Both scintillating and nonscintillating clutter are considered. Author (TAB)

N68-30416# Army Electronics Labs., Fort Monmouth, N. J.
MATHEMATICAL MODEL OF A RECEIVER FOR USE IN INTERFERENCE AND COMPATIBILITY EVALUATIONS
Nello R. Castellini Jan. 1968 45 p refs Revised
(ECOM-2924; AD-669745)

The work develops the mathematical model of a radio receiver operating in an interference environment. Amplitude and frequency modulation are treated. Linear and non-linear effect on the field ensemble are considered. The underlying criterion used in the model is the signal-to-noise power ratio after detection. This ratio is shown to have a frequency distribution that is a function of the distribution of the attenuations of the signals contributing to it. The probability of interference is shown to be a function of the difference between the values of the distribution functions of the ratios with and without interference for the value of signal-to-noise ratio required of the circuit. Author (TAB)

N68-30428# Harry Diamond Labs., Washington, D. C.
A WIDEBAND RECEIVER FOR DIRECTION-SENSITIVE DOPPLER RADARS
Raymond H. Femenias Apr. 1968 14 p refs
(HDL-TR-1373; AD-669740)

The direction-sensitive doppler radar, a system concept originated in HDL, requires the introduction of a 90-deg phase displacement between two doppler signals. This had restricted the receiver bandwidth to about 3 octaves because of the interchannel amplitude discrepancy caused by available phase shifters. A new quadrature phase shifter with a constant output over a large frequency range has been developed. The performance of an experimental receiver incorporating this new phase shifter is described. It has a 7-octave bandwidth. Author (TAB)

N68-30440# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STATISTICAL DECISION METHOD OF DETECTING AND ESTIMATING PARAMETERS OF RADAR SIGNALS
Teh-hang Chu 31 Aug. 1967 31 p refs Transl. into ENGLISH from Tien Tzu Hsueh Pao (Communist China), no. 1, 1963 p 3–18
(FTD-HT-67-243; AD-670104)

The author deals with the problem of detection and estimation of parameters of radar signals in the Gaussian white noise from the point of view of statistical decision theory. The design principle of the optimum radar receiver for signals of unknown parameters is given according to the characteristics of the high-speed distance target and the purposes of radar systems. Unified detection procedures are established, and the construction and performance of optimum radar receivers are obtained. The block diagrams of results are also shown. Emphasis is given to cases where prior distributions are unknown, while only two parameters, velocity and distance, are discussed for cases where prior distributions are known. In the latter case, the optimum estimations of the two parameters and their properties are derived from the absolute loss criterion. Author (TAB)

N68-30442# Signals Research and Development Establishment, Christchurch (England).
ENVIRONMENTAL NOISE TEMPERATURE AT 50 CM
I. D. R. Smith Jan. 1968 36 p
(SRDE-67004; AD-670439)

The report investigates the Noise Temperature of a 5 ft parabolic antennas as a function of elevation and azimuth angles, at a wavelength of 50 cm. The vertical polar diagram of the aerial is also determined such that the relationship of the ratio of aerial gain and noise temperature to elevation angle could be calculated, with a view to the possibility of operating line-of-sight communication antennae at elevation angles greater than zero and giving enhanced system performance. Author (TAB)

N68-30478# Aerojet-General Corp., Azusa, Calif. Microelectronics Div.
DEVELOPMENT OF MICROELECTRONIC ELECTRONICALLY TUNED RECEIVER TUNER Quarterly Report, 1 Jan.–1 Apr. 1968
R. A. Russell, D. W. Lewis, and D. C. Brayton 1 Apr. 1968 50 p
(Contract DAAB07-67-C-0600)
(AGC-1166-01-3; ECOM-0600-3; QR-3; AD-670024)

The purpose of this program is to design an electronically tuned, VHF receiver tuner to determine the feasibility of using thin-film microelectronics to accomplish all receiver functions in the next generation of VHF tactical radios. Two developmental feasibility models are being fabricated and tested to ensure compliance with the performance requirements. During this, the third quarter, the masks for the thin-film deposition process were manufactured; circuits were deposited and probed; and, a complete hybrid thin-film electronically tuned receiver tuner was constructed. This report tells about mask design layout revision and contains in the Appendix a data packet that describes layouts and schematics as well as resistor and capacitor design parameters and other information necessary to the thin-film manufacturing process. Component layout is described as is the technique for making mask drawings and mask manufacturing. Thin-film manufacturing testing techniques are described. The design and sequence of manufacturing of the complete receiver tuner are described. A schematic diagram and layout of the resistor divider network and a photo of an assembled high-band receiver tuner are shown. Author (TAB)

N68-30526# Eidgenossische Technische Hochschule, Zurich (Switzerland).
AUTOMATIC CORRECTING OF TRANSMISSION-DEPENDENT PHASE-ERRORS AND AMPLITUDE-ERRORS OF COLOR TELEVISION SIGNALS [AUTOMATISCHE KORREKTUR PEGELABHAENGIGER PHASEN- UND AMPLITUDENFEHLER VON FARBFERNSEHSIGNALEN]

Fausto Pellandini (Ph.D. Thesis) 1967 113 p refs In GERMAN
Its Dissertation No. 3954
CFSTI: HC $3.00/MF $0.65

Linear functions are used to analyze those color vision signal distortions that are caused by nonlinear transmission systems and to establish qualitatively the dependency of the color information error on signal brightness. Developed differences between first and second order errors are then used to formulate and construct an automatic variable corrector for differential amplitude and phase errors in the color signal. Transl. by G.G.

N68-30529*# Purdue Univ., Lafayette, Ind. School of Electrical Engineering.
PERFORMANCE OF SELF BIT SYNCHRONIZERS FOR THE DETECTION OF ANTICORRELATED BINARY SIGNALS
P. A. Wintz and E. J. Luecke Jun. 1968 139 p refs
(Grant NsG-553)
(NASA-CR-95890; TR-EE68-1; PRF-4695) CFSTI: HC $3.00/MF $0.65 CSCL 17A

This research is concerned with optimum and suboptimum ways of providing self synchronization for binary anticorrelated signaling. Expected absolute error, as determined from the probability density function of synchronizing error, is used as the performance measure when no detector is specified. Degradation of effective signal to noise ratio is used as the performance measure for operation with a correlation detector. A maximum likelihood synchronizer is derived and its performance evaluated by Monte Carlo techniques. The structure of the optimum synchronizer is complex but it leads to a suboptimum system composed of a cascade of a low pass filter, square law nonlinearity, and a band pass filter centered at the symbol rate. This system is analyzed and its performance as function of its parameters is presented and compared with the optimum synchronizer. A system for testing prototype synchronizers is described and experimental results for the suboptimum synchronizer and several other prototype systems is presented. Author

N68-30600 Japan Broadcasting Corp., Tokyo. Broadcasting Science Research Labs.
VISIBILITY OF MONOCHROME TELEVISION RANDOM INTERFERENCES AND ITS MEASUREMENT
Yukiya Yamaguchi Feb. 1968 20 p refs *Its* No. 11

Studies on random noise visibility in monochrome television are reviewed in relation to noise visibility as a function of frequency, and noise visibility over the gray scale. An analysis was performed to determine random noise visibility under different television standards. A linear summation of the noise visibility with the individual frequency component of the noise spectra was assumed, and the weighting function from the horizontal and vertical spatial spectra of television raster displaying random noise over a uniform background was studied. It was found that the beam aperture response of the picture tube and the response of human vision to random noise will not change at the spatial frequency scale for various television systems. Therefore, the video weighting functions for random noise in different television standards must be identical except that its reference frequency is varied in proportion to line frequency. Subjective experiments on the relative visibility of octave-band random noise in 12 television standards verified the analysis. Design principles are presented on an instrument developed for measuring the noise level of an individual head of a four-head television tape recorder as a function of the signal level. Author

N68-30610# Boeing Co., Renton, Wash. Airplane Div.
A STUDY OF THE TRANSMISSION OF ELECTROMAGNETIC WAVES THROUGH A PERIODICALLY APERTURED CONDUCTING SCREEN BY VARIATION METHOD
S. Y. Peng May 1968 112 p refs
(D6-19559; AD-670304)

The document presents a theoretical and experimental investigation of the transmission coefficient of a periodically apertured plane conducting screen for all angles of incidence. Equations are formulated by variational methods and equivalent circuit concept. Measurements as well as calculations are made to verify the theoretical analysis. Numerical results of the equivalent susceptance for normal incidence are included and discussed. The results can be important in the further study of the design of a fenestrated metal radome and rain erosion metal cap and other applications. Author (TAB)

N68-30682# Ohio State Univ., Columbus. ElectroScience Lab.
A COMPUTER PROGRAM FOR BACKSCATTER BY SMOOTHLY JOINED, SECOND DEGREE SURFACES OF REVOLUTION
C. E. Ryan, Jr. Apr. 1968 33 p refs
(Contract AF 19(628)-67-C-0308)
(OSURF-2430-6; ESD-TR-68-213; AD-669807)

A computer program for calculation of the echo area of smoothly joined, N section convex conducting surfaces, described by a second degree equation is described. For the case of E theta (parallel) polarization of the incident and scattered fields the solution is obtained by a combination of geometrical optics and creeping wave theory. For the case of E phi (perpendicular) polarization the solution is obtained using geometrical optics, and the creeping wave is neglected. The computed results for E theta polarization are in good agreement with measurements for prolate spheroids, prolate spheroid-sphere, and prolate spheroid-oblate spheroid combinations. Author (TAB)

N68-30688# Ohio State Univ., Columbus. ElectroScience Lab.
A COMPUTER PROGRAM FOR BACKSCATTER BY TARGETS COMPOSED OF CONES, CYLINDERS, AND DISKS
C. E. Ryan, Jr. Apr. 1968 39 p refs
(Contract AF 19(628)-67-C-0308)
(OSURF-2430-5; ESD-TR-68-212; AD-669808)

This report describes a computer program for determining the backscattered fields of a conducting body of revolution composed of sections of cones and cylinders. The target may be closed at one or both ends with circular disks. The target may have as many as 20 sections, and the program can readily be modified to handle a larger number. The backscattered field for E theta or E phi polarization is computed using wedge diffraction theory and geometrical optics. The computed results are in good agreement with experimental measurements for cones, cylinders, double cones, and conically capped cylinders. Author (TAB)

N68-30801# Aerospace Corp., El Segundo, Calif. Lab. Operations.
DESIGN OF ZIGZAG FM SIGNALS
A. W. Richaczek and R. L. Mitchell Jan. 1968 44 p refs
(Contract F04695-67-C-0158)
(TR-0158(3230-46)-7; SAMSO-TR-68-152; AD-670155)

Since no practical method is available for synthesizing radar waveforms, a sizable effort has been directed into studies of the matched-filter response, or ambiguity function, of many waveforms. In this paper, we investigate the class of FM signals whose instantaneous frequency varies in a zigzag pattern. The waveforms thus consist of linear FM segments and are relatively easy to generate and process. The paper discusses the relation between the characteristics of the waveform and the features of the associated ambiguity function. The effects studied include those of signal repetition, changes in the FM slope, phase shift coding and frequency shift coding, and staggering of frequency step and segment duration. Ambiguity functions of interesting waveforms illustrate the general results. These ambiguity functions are computer-plotted projections of the three-dimensional surface above the delay-Doppler plane. Author (TAB)

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics.

N68-29684# Armed Forces Radiobiology Research Inst., Bethesda, Md.
A TECHNIQUE FOR CONVERTING A KEY PUNCH INTO A COMPUTER PUNCHED CARD READER
L. J. Brocato, J. J. Gitelman, and R. W. Rockwell Dec. 1967 29 p
(AFRRI-TN-67-4; AD-669379)

The report describes a technique for converting a key punch into a punched card reader for use with a small-scale special purpose computer system. The discussion includes a system description, hardware modifications, software analysis and a descriptive software listing. Author (TAB)

N68-29690# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CERTAIN TIMING CHARACTERISTICS OF A MULTIPANEL CALCULATING SYSTEM
M. V. Mishurnaya 1 Sep. 1967 13 p Transl. into ENGLISH from An Bssr. Inst. Tekhn. Kibernetiki. Vychislitel'naya Tekhn. (Minsk), 1965 p 14–20
(FTD-MT-24-232-67; AD-669308)

The present paper is a sequel to one entitled The Multi-terminal Computer by the same author. Each terminal is an input/output teletypewriter linked to a buffer section in the main unit. An interrupt subroutine in the computer is initiated from the input buffer when new data are fed from one of the terminals or when the results of calculations are to be transmitted back to a particular terminal. This subroutine contains provisions for a delay and certain priority decisions to allow for an orderly processing of information by the computer. The time required for a processing of a problem originating from a terminal is calculated. The delay time for the simultaneous operation of several terminals is analyzed and the appropriate formulas are given. All derived expressions are valid for any multi-terminal computer system. The operation of an installation in which the I/O terminals are arranged in groups is discussed and its advantages are pointed out. In this system several terminals time-share a single communication line and a single section in the input buffer. TAB

N68-29705# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A MEMORY UNIT FOR A 16,000 CHANNEL MULTIDIMENSIONAL ANALYZER [ZAPOMINAYUSHCHEYE USTROYSTVO DLYA MNOGOMERNOGO ANALIZATORA NA 16000 KANALOV]
N. V. Meshkov and P. V. Nesterov 6 Jun. 1967 18 p refs Transl. into ENGLISH from Radiotekhn. (Moscow), 1963 p 62–71
(FTD-HT-23-960-67; AD-669516)

Multidimensional analysis requires a large capacity memory and for this purpose magnetic tape is considered most expedient. However, lack of control over information during storage and the need for additional processing using a sorter are considered substantial disadvantages of magnetic tape recording. The authors constructed a 16000-address ferrite core storage which can operate either directly as the memory of the multidimensional analyzer or as a sorter for processing magnetic tape data. The large memory makes it possible, in a number of cases, in one pass to transcribe all information from one or several tapes and obtain a graphic picture of the spectrum. In this report they provide the characteristics of the memory and describe the operation of its individual elements. Author (TAB)

N68-29776# Hawaii Univ., Honolulu. Dept. of Electrical Engineering.
PROBLEMS IN INFORMATION PROCESSING Final Scientific Report, 1 Oct. 1964–30 Sep. 1967
S. Lin, W. W. Peterson, and E. J. Weldon, Jr. 1 Nov. 1967 61 p refs
(Contract AF 19(628)-4379)
(AFCRL-67-0566; SR-15; AD-669838)

The final report summarizes research for a three-year project. Abstracts for the fourteen scientific reports are given, and some new results are included on generalizations of Reed-Muller codes, Reed-decoding algorithms, majority logic decoding, cyclic product codes, and the MacWilliams identity. Author (TAB)

N68-29966# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE QUESTION OF DIGITAL PERCEPTRON SYNTHESIS [K VOPROSU SINTEZA DISKRETNOGO PERSEPTRONA]
K. N. Denisov and E. N. Perevezentsev 4 Aug. 1967 18 p refs Transl. into ENGLISH from Tr. Tsentr. Nauchn.-Issled. Inst. Morsk. Flota (Leningrad), no. 77, 1965 p 82–88
(FTD-MT-24-203-67; AD-669270)

The article presents a solution to the problem of synthesizing the logical net of a digital perceptron based on optimum coding and linear programming methods. The structural circuit utilizes simultaneously both recurrent and nonrecurrent forced learning procedures. The recurrent procedure for learning to recognize objects (presented by binary numbers) is based on the simplex method of linear programming. The nonrecurrent procedure is based on the Browning-Bledsoe method of binary digital recognition. Information signs of recognized forms are extracted by computer procedures in general coding (in the sense of the Browning-Bledsoe method), leading to an investigation of the fine structure of the binary numbers by methods in the theory of optimum coding. The algorithms of optimum coding of binary numbers are based on a comparison of divergence and entropy of a series of possible states of the recognition device. Optimum selections of the weighted coefficients in the logical net are determined on the basis of algorithms of the simplex method using digital computers. The authors conclude that the further development of the theory of discrete (digital) perceptron depends on perfecting the recurrent and nonrecurrent learning procedures in pattern recognition devices which involves the use of more general computational methods of mathematical programming. Author (TAB)

N68-29986# Mitre Corp., Bedford, Mass.
COLINGO C-10 USERS' MANUAL, VOLUME 2 Technical Report, 15 Dec. 1965–23 Feb. 1968
May 1968 166 p
(Contract AF 19(628)-5165)
(MIR-35; ESD-TR-66-653, V. 2; AD-669326)

The COLINGO C-10 Users Manual, a combination of tutorial and reference material, is presented in two volumes. This volume contains information on machine configurations, procedures for operating and loading the system, a description of the C-10 general purpose macro facility (terses and actors), a guide to the STEP language, a set of instructions for preparing machine procedures, and a list of system error messages. Author (TAB)

N68-30007# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
INPUT OUTPUT CONTROL SYSTEM FOR A REAL-TIME COMPUTER (APPLIED TO SDS 930) [SYSTEME DE GESTION DES ENTREES-SORTIES D'UN CALCULATEUR EN TEMPS REEL (APPLICATION AU CAE-30-40)]

Francis Aboulker (Ph.D. Thesis—Paris Univ.) Feb. 1968 229 p refs In FRENCH; ENGLISH summary
(CEA-R-3471) CFSTI: HC$3.00/MF$0.65

This program is an input output control system for the different channels and relieves the programmer of its programmation. Programs are recursive because of real-time and a symbolic name can be given to peripheral units. A priority is assigned by the control system. Recursivity is solved by a stack, and a list system is used for recording tasks and data editing. For each call to an edition subroutine, a work note is created and buffers for information to be edited are filled up if necessary. The work note is linked to a pointer corresponding to the channel-dependent priority list. The execution program scans systematically the priority list after each input or output, thus working for the peripheral unit having the greatest priority. Author (ESRO)

N68-30088*# Radio Corp. of America, Princeton, N. J. Astro Electronics Div.
LAMINATED FERRITE MEMORY SYSTEM
9 Aug. 1968 122 p
(Contract NAS1-7084)
(NASA-CR-66636; AED-R-3325) CFSTI: HC $3.00/MF $0.65
CSCL 09B

Studied was the feasibility of developing a 131,072-bit random-access laminated farrite memory system suitable for use in space flight. Based on the results, a preliminary design for an engineering model was performed. All program goals, except power consumption, were found feasible using state-of-the-art ferrite materials and peripheral driver, logic, and sensing devices. Total estimated power consumption was 25 watts at a 2-microsecond memory cycle time. Possible reductions in power are discussed. Determined were optimal memory wafer size, laminated ferrite material characteristics, and optimal methods of driving, terminating, and switching memory plane, work, and digit lines. A failure rate analysis yielded an estimated 83.3% probability of survival for one year in the space environment. Author

N68-30100# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
SOME PROBLEMS IN THE EVALUATION OF EXTERNAL-ACCESS WRITE-READ FERRITE STORAGE DEVICES [NEKTORYE VOPROSY OTSENKI SISTEM ZAPISICHTENIYA ZAPOMINAYUSHCHIKH USTROISTV NA FERRITAKH S VNESHNIM VYBOROM]
V. N. Sorokin and N. P. Vashkevich 7 Jul. 1967 20 p refs Transl. into ENGLISH from Zap. Penza Politekhn. Inst. (USSR), no. 1, 1964 p 3–16
(FTD-HT-23-915-67; AD-669508)

The operation of a square-loop-ferrite storage element is investigated; two or more cores linked together are required for each binary digit. The core operation is described by a system of equations, and formulas are given for turnover currents, which allow for the turnover-current front-rise time. These formulas permit evaluating the effect of core parameters and link resistance on the speed of operation. Various modifications of the write-read systems are compared by the complexity of their control circuits, the number of exciting devices for number-link access, by their rates and the requirements of exciting fields under write-read conditions. The results of analysis are tabulated. TAB

N68-30122# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CERTAIN DESIGN ALGORITHMS OF DIGITAL COMPUTERS [NEKOTORYE ALGORITHMY PROEKTIROVANIYA TSVM]
Ya. I. Fet 14 Sep. 1967 21 p refs Transl. into ENGLISH from Vychislitel'nyye Sistemy, Inst. Mat., Sibirsk. Otd. Akad. Nauk SSSR (USSR), no. 18, 1965 p 72–91
(FTD-MT-24-233-67; AD-670115)

The possibility of using a computer for the automation of the conversion from a functional to a principle circuit in the designing of a computer is studied. An algorithm is described for logical mapping of functional circuits. The mapping consists in recurrent time solution of a system of logical equations with successive comparison of obtained values for output variables with expected results. A circuit diagram is given for the program of logical mapping. Author (TAB)

N68-30123# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ANALOG-DIGITAL MULTIPLIERS [ANALOGO-TSIFROVYE MNOZHITELNYE USTROISTVA]
T. F. Bekmuratov, B. N. Malinovskiy, and V. P. Skuridin 21 Jul. 1967 13 p refs Transl. into ENGLISH from Izv. Akad. Nauk Uz. SSR, Ser. Tekhn. Nauk (Tashkent), no. 6, 1965 p 8–13
(FTD-MT-24-139-67; AD-670112)

The report reviews operating principles of analog digital computer systems. Grouping these by type of output (i.e., in analog or digital form), the authors attempt a classification by the method underlying the analog to code and code to analog conversions. Six design principles are illustrated. Author (TAB)

N68-30138# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AN IMMEDIATE-ACCESS BUFFER (MEMORY UNIT) FOR AN ELECTRONIC COMPUTER [BUFERNOE OPERATIVNOE ZAPOMINAYUSHCHEE USTROISTVO DLYA ELEKTRONNOI VYCHISLITELNOI MASHINY]
V. A. Fedorov 7 Jul. 1967 20 p Transl. into ENGLISH from Tr. Mirovoy Meteorol. Tsentr. (USSR), no. 10, 1965 p 103–111
(FTD-MT-24-128-67; AD-669419)

A buffer operational storage device (BOZU) based on magnetic operational storage devices and buffer coordinating units is used to operate the computer complex for weather forecasting at the SSSR world Meteorological Center. The BOZU provides simultaneous storage of information from different devices with the proper ordering and preprocessing of this information. It also controls the operation of all devices connected with the computer. In one array of the complex the unit automatically receives data from communications channels and records it on one of several buffer tapes to abbreviate the computer input process. The system can also predigest punched cards to expedite their input. The BOZU also accepts the computer output and expedites the dispatch of this information to such associated equipment as automatic chart plotters and weather forecast transmission channels. The computer time utilization is so efficiently coordinated that in one of the most complex operational modes the receiving and transmitting of information from the computer requires only 30% of the computer time, leaving the remaining 70% for computer analysis. TAB

N68-30180# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.
SYSTRAN (SYSTEMS ANALYSIS TRANSLATOR): A DIGITAL COMPUTER PROGRAM Final Report, Aug. 1965 - Oct. 1966
E. B. Weis, Jr. and D. J. Lateunesse Dec. 1967 28 p refs
(AMRL-TR-65-133, SUP.2; AD-670161)

SYSTRAN was originally developed around a data acquisition system and was primarily intended for use in analysis of periodic and transient data. It was modified to include some capability for handling random data. In use, the program was found to be cumbersome in that a tremendous number of control cards were

needed to accomplish certain types of data analysis. A new system was added to allow program controlled generation of these cards. Also a few additional capabilities were included to extend the usefulness of the system. Specifically, this report describes a control card generator, an option to allow redefinition of Fourier Transforms over parts of the frequency range, an option to allow direct loading from cards of Fourier Transforms, an extension of the digital filter length, a major modification of the existing auxiliary system and other minor corrections and modifications. Author (TAB)

N68-30201# European Atomic Energy Community, Ispra (Italy). Reactor Physics Dept.
A TIME-OF-FLIGHT ANALYZER BASED ON A SMALL ON-LINE COMPUTER
H. J. Metzdorf Brussels Jun. 1968 46 p refs
(EUR-3933.E) CFSTI: HC $3.00/MF $0.65

A program is described for a small on-line computer used as a time of flight analyzer. The structure of its pseudo code is explained and the details of a sample run are given. Author

N68-30240*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
SOME LABORATORY TECHNIQUES OF WAVE ANALYSIS WITH APPLICATION TO THE APOLLO PROGRAM
Roy A. Watlington Aug. 1968 49 p refs
(NASA-TM-X-1599; S-157) CFSTI: HC $3.00/MF $0.65 CSCL 09B

Time and frequency correlation, root-mean-square time histories, and power-spectral density analysis techniques are applied not only in perfecting communication systems but also in gaining vital information on the chemical and physical nature of things. The sophisticated instruments and techniques of the present age have made it possible to record, synthesize, and analyze wave data rapidly and in depth. This paper examines and discusses some of the major techniques of wave analysis being applied to the Apollo Program, describes the instrumentation involved, and provides an illuminating mathematical foundation for the analyses. Author

N68-30261*# Laboratory for Electronics, Inc., Boston, Mass. Magnetic Memory and Logic Development Dept.
STUDY OF ADVANCED ASSOCIATIVE PROCESSOR TECHNIQUES Interim Report
Harvey I. Jauvtis Feb. 1968 172 p refs
(Contract NAS12-543)
(NASA-CR-86076) CFSTI: HC $3.00/MF $0.65 CSCL 09B

The application of DTPL (Domain Tip Propagation Logic) to the design of an associative processor has been studied. This report represents the results of the first six-month's work effort in which solutions to most of the basic problems have been obtained. In particular, work selection logic and memory cell structures have been designed, implemented and found to function satisfactorily. Techniques for performing the various search and processing operations required of an associative processor for spaceborne applications have been developed and methods for reducing the basic search cycle time considered. Materials and fabrication studies were undertaken in an effort to improve upon existing multilayer and laminated film techniques. The report concludes with a preliminary design for a 1000 word, 100 bit per word DTPL associative processor. Author

N68-30275*# Carson Labs., Inc., Bristol, Conn.
INVESTIGATION OF TEN TO THE TENTH POWER BIT OPTICAL MEMORY Final Report, 1 Apr. 1967–31 Jan. 1968
Richard E. Kearney Cambridge, Mass. NASA. Electronics Research Center Mar. 1968 35 p
(Contract NAS12-125)
(NASA-CR-86075) CFSTI: HC $3.00/MF $0.65 CSCL 09B

A series of experiments was conducted to obtain engineering data on the properties of potassium bromide crystals as optical data storage media. Parameters monitored were optical sensitivity, color uniformity, volume sensitivity, readout properties, reuseability and long term retention of information. Recommendations are given for improvements required for utilization of these crystals as high capacity data storage media. Author

N68-30280*# University of Southern Calif., Los Angeles. Electronic Sciences Lab.
THE SYNTHESIS OF PERIODIC SEQUENTIAL MACHINES
R. A. King and W. S. Meisel May 1968 38 p refs
(Grant NGL-05-018-044)
(NASA-CR-95880; USCEE-278) CFSTI: HC $3.00/MF $0.65 CSCL 09B

The effects of loops upon the conversion of a sequential machine into a periodic machine are examined, and theorems and corollaries derived which predict the allowable periods for non-trivial periodic machine equivalents of sequential machines. A periodization procedure is developed and presented. The theorems and corollaries are initially derived for minimal, strongly connected sequential machines, and then extended to include non-minimal, non-strongly connected sequential machines, as well. Author

N68-30326# California Univ., Berkeley. Lawrence Radiation Lab.
AN ERROR-CORRECTING DATA LINK BETWEEN SMALL AND LARGE COMPUTERS
Sypko W. Andreae and Robert W. Lafore, Jr. 16 Jan. 1968 19 p Presented at the Am. Federation of Inform. Processing Soc. Spring Joint Computer Conf., Atlantic City, 30 Apr.–2 May 1968 Submitted for publication
(Contract W-7405-ENG-48)
(UCRL-17999; CONF-680417-1) CFSTI: HC $3.00/MF $0.65

A data link for connecting small data-acquisition computers to a central CDC 6600 computer is described. Operation and design problems are discussed. NSA

N68-30368*# University of Southern Calif., Los Angeles.
RELIABILITY IN DIGITAL SYSTEMS WITH ASYMMETRICAL FAILURE MODES
W. S. Meisel and P. C. Schaeffer [1968] 21 p refs
(Grant NGL-05-018-044)
(NASA-CR-95886) CFSTI: HC $3.00/MF $0.65 CSCL 09B

Most present day reliability schemes using redundancy to mask the failure of individual logic modules employ majority voting with the assumption that the replicated modules have symmetrical failure characteristics. This paper presents an analysis of such schemes when the modules exhibit asymmetrical failure modes; that is, the probability that a module fails with a 0 output is not equal to the probability that it fails with a 1 output. Fail-safe logic systems (discussed by other authors) fall in this category. A general expression is presented which gives the reliability of a network consisting of n identical modules feeding a k-out-of-n voter. It is shown that a simple majority element does not always represent the optimal choice. Plots for selecting the optimal k for n = 3,4,5 when the individual module reliability parameters are known are presented. Also included are graphs of network reliability in terms of individual module reliability and the degree of asymmetry. Author

N68-30374# Stanford Research Inst., Menlo Park, Calif.
THEORY OF CELLULAR LOGIC NETWORKS AND MACHINES Final Report, 1 Mar. 1966 – 31 Dec. 1967
Bernard Elspas and James B. Turner Jan. 1968 102 p refs
(Contract AF 19(628)-5903)
(AFCRL-68-0148; AD-669825)

The report represents final results of a first project concerned with the theory of cellular logic networks and machines. The ultimate objective of this program is the development of effective mathematical techniques for the analysis and synthesis of cellular logic networks and machines. The report covers the subjects of interconnection structures for cellular logic networks, mathematical models for non-array structures, representations of intracell logic functions, and computer programs for the analysis, manipulation, and transformation of graphical interconnection structures and intracell logic functions. Author (TAB)

N68-30404 Harry Diamond Labs., Washington, D. C.
A NONVOLATILE CERAMIC MEMORY DEVICE – AN ALTERNATE STRUCTURE
C. W. H. Barnett Mar. 1968 28 p ref
(HDL-TR-1384; AD-669739)

A newly designed nonvolatile ceramic memory device was fabricated and evaluated. This device is 0.55 in. in diameter, 0.010 in. in thickness, and contains 12 memory cells. For each cell information is inserted on one lead and readout is taken on a second lead; therefore, no internal mechanical switching is required. Each memory cell has two stable states: one that produces a high voltage output (one) and one that produces a low voltage output (zero). These two conditions, which remain stable even when the power is switched off, enable each cell to store one binary bit that is recoverable nondestructively by a simple voltage detecting circuit. From -50 to +80C the output voltages vary slightly with temperature, but the lowest voltage one is never less than 1.4 V greater than the highest voltage zero. One is written into the memory cell by a d-c voltage of +360 V; the zero, by a d-c voltage of -270 V. Both voltages are applied for a noncritical time of about 1 sec. Author (TAB)

N68-30405# RAND Corp., Santa Monica, Calif.
DISPLAY – A GUIDE TO THE TRACK FORTRAN DEBUGGING SYSTEM
D. C. Mac Neilage May 1968 42 p
(Contract F44620-67-C-0045; Proj. RAND)
(RM-5618-PR; AD-669801)

TRACK is a FORTRAN program designed to aid in the debugging of other FORTRAN programs. TRACK follows all, or selected parts, of the execution of a program step by step and reports via the output file the result of each step. This is done by suitably rewriting the program to be tracked in FORTRAN and storing the result on disc file TAPEQ. The latter retains the program name of the original program and may be compiled and executed as any other FORTRAN program. Author (TAB)

N68-30423# Washington Univ., St. Louis, Mo. Computer Systems Lab.
ANALYSIS OF IMPLEMENTATION ERRORS IN DIGITAL COMPUTING SYSTEMS
Robert M. Keller and Donald F. Wann Mar. 1968 98 p refs
(Contract ARPA SD-302; Grant NIH G-FR-00218; ARPA Order 655)
(TR-6; AD-669812)

This report discusses problems encountered with control networks in highly restructurable digital systems. In particular the treatment of implementation errors is covered with emphasis on concurrent processing. The implementation of concurrent processing networks may result in errors which will be quite complex to detect and systematic methods are warranted. A model representing a particular type of computing system is presented, and methods for introducing concurrent control into the model discussed. The automatic detection of a certain class of errors caused by improper design of these systems is investigated. Graph theoretic representation is employed in demonstrating several error detection techniques. The properties of these techniques are compared and it is concluded that one technique, of those investigated, is of sufficient generality, thoroughness, and simplicity in implementation to be used for automatic error analysis. Author (TAB)

N68-30437# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON SOME METHODS OF CONVERTING ADDRESS ALGORITHMS [O NEKOTORYKH PREOBRAZOVANIYAKH ADRESNYKH ALGORITMOV]
V. N. Porshneva 12 Sep. 1967 16 p refs Transl. into ENGLISH from the book "Kibernetika i Tekhnika Vychisleniy" Kiev, Izd. Naukova Dumka, 1964 p 84–93
(FTD-HT-67-219; AD-670099)

The report describes a method of formal conversion of address algorithms, with the goal of reducing the initial address representation (and thereby the memory space required). The theorem of the possibility (under certain conditions) of compressing individual groups of addresses used in the address algorithm is proven. The method suggested is illustrated by an example of sequential transformations of a program for multiplication of a matrix by a vector. TAB

N68-30477# National Bureau of Standards, Washington, D. C. Computer Technology Section.
COMPUTER/DISPLAY INTERFACE STUDY Quarterly Report, 1 Jan.–30 Jun. 1967
Paul Meissner, Thomas N. Pyke, Jr., and Don E. Rippy Feb. 1968 44 p Prepared for Army Electron. Command
(ECOM-95844-4; QR-4/5; AD-670025)

During the fourth and fifth quarterly reporting period the MOBIDIC-B computer facility including the MAGIC display equipment was thoroughly checked out. The design of MAGIC II advanced to the point where purchase of major components could be undertaken and construction initiated. The processor and the display console will be housed separately, to allow a more flexible arrangement. The logic circuitry for MAGIC II is being assembled and checked out in stages to permit engineering modifications if required. The report includes a paper considering the engineering aspects of computer display systems. Author (TAB)

N68-30491# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE MULTIAPERTURE FERROMAGNETIC CORE AND ITS APPLICATIONS
Hsueh-Shih Chang 13 Sep. 1967 17 p refs Transl. into ENGLISH from Tien Tzu Chi Shu, no. 9, 1965 p 26–29
(FTD-HT-67-240; AD-670103)

The principle of a six-aperture ferrite magnetic core is described. It was shown that this multi-aperture core can be used to form logistic circuitry such as an OR circuit, and AND circuit, a negative gating circuit or a sequential circuit. This logistic circuitry has many applications. Four applications of the core are described: in control devices, in a half adder, in an 11 logistic device and in a simple data interpreter. TAB

N68-30512# Stanford Research Inst., Menlo Park, Calif.
GRAPHICAL-DATA-PROCESSING RESEARCH STUDY AND EXPERIMENTAL INVESTIGATION Quarterly Report, 1 Dec. 1967–29 Feb. 1968

John H. Munson May 1968 33 p
(Contract DA-28-043-AMC-01901(E))
(SRI-30; ECOM-01901-30; QR-8; AD-670054)

This report describes the continuing development of scanning, preprocessing, character-classification, and context-analysis techniques for hand-printed text, such as computer coding sheets in the FORTRAN language. A series of learning-machine classification experiments were performed on a file of hand-printed characters containing 147 FORTRAN alphabets from 49 authors. The best results obtained fell far short of those for analogous experiments, reported earlier, where the training and testing characters were printed by a single author. We describe some early results relating to the problem of manipulating the adaptive weights of the MINOS II learning machine directly and individually from the SDS 910 computer. Author (TAB)

N68-30577# Aeronutronic, Newport Beach, Calif.
A HYBRID COMPUTER FOR IMAGE SPATIAL FILTERING IN NONCOHERENT LIGHT Annual Summary Report
Terry T. Katayama Apr. 1968 60 p
(Contract Nonr-2913(00))
(U-4382; AD-669809)

Efforts were made to investigate and perform parallel image logic experiments with an image storage tube utilizing inputs from pictorial data. Attempts were made to learn to recognize features which can be recognized by the human eye with such a device. To achieve these goals, a study was made on image storage tube computations. To perform the parallel image logic experiments, the cybercon was designed and built, and is described in detail. Results of experimental efforts to recognize features are also presented. In the latter phase of this contract period, a two-tube cascaded experimental setup was constructed. Author (TAB)

N68-30629*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
PARACTOR, A NEW TOOL FOR ACCURATE DC AMPLIFICATION AND DIGITAL DATA TRANSMISSION
Thomas L. Greenwood *In its* Res. Achievements Rev., Vol. 11 1968 p 33–38 (See N68-30625 18-14)

Details are given on the development of a 120-channel digital data acquisition system and on the modifications made to the Paractor (parametric reactor) circuit. This comparator circuit transfers a high level replica of the input signal, through a tight feedback loop, to a convenient point for analog to digital conversion. The comparator unit includes a pulsed Paractor, a pulse oscillator for driving the Paractor coils, an integrating amplifier, and resistance network for the feedback voltage providing the potentiometric measurement. A precision dc amplifier with improved characteristics was also obtained by using techniques developed for the digital system. It is reported that checkout of the system demonstrated good stability under unfavorable environmental conditions, such as temperature extremes and vibration. M.G.J.

N68-30665# Illinois Univ., Urbana. Dept. of Psychology.
A FORTRAN 2 PROGRAM FOR MUDAID: MULTIVARIATE, UNIVARIATE, AND DISCRIMINANT ANALYSIS OF IRREGULAR DATA
Mark Appelbaum and Rolf E. Bargmann Dec. 1967 95 p
(Contracts Nonr-1834(39); N00014-67-A-0305-0003)
(AD-669696)

A FORTRAN II program for a Multivariate, Univariate, and Descriminant Analysis of Irregular Data (MUDAID) is presented. This program is an extension of the programs ANOT and SLTD of the IBM Components Division to provide multivariate and discriminant analysis options. The data may be irregular both in the sense of unequal and non-proportional numbers of observations per factor combination in design of experiments and in the sense of unedited data obtained from automated data recording devices. A first-run of the program with a body of data produces indications of outlier observations and other peculiarities to be adjusted in editing. A complete description of the method of analysis and usage is given as well as a complete listing of the program. Author (TAB)

N68-30678# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ANALOG COMPUTERS, PART 2, SECTION 5
V. P. Bodunov, Ya. I. Dubinin et al 22 Sep. 1967 56 p Transl. into ENGLISH from the book "Vychislitel'nyye Mashiny Nepreryvnogo Deystviya" Moscow, 1965 p 146–185, 211–212
(FTD-MT-24-138-67; AD-670080)

The document is comprised of a portion of workbook intended for use in an engineering laboratory course on analog computers. The portion included deals with model electronic machines and methods of their application, with special reference with the Mn-7 and IPT-5 computers. TAB

N68-30739# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A PARALLEL MACHINE SIMULATOR BASED ON THE SEQUENTIALLY OPERATING MACHINE GAMMA-BARABAN [IMITATOR PARALLEL'NOY MASHINY NA POSLEDOVATEL' NOY MASHINE GAMMA-BARABAN]
N. M. Yermolayeva and M. A. Probst 21 Sep. 1967 5 p Transl. into ENGLISH from Akad. Nauk. SSR., Inst. Nauchn. Inform. Sistemy (USSR), 1964 p 15–17
(FTD-HT-67-2; AD-670256)

A machine is described which has parallel-operating independent devices, a command memory and two constant memories. The command of the parallel machine contains two addresses, each of which indicates a cell of its own operational memory. Information reaches the device over command bars and constant bars. At any moment, only one number (or one command) can pass over each bar. The several different modes in which the sampling device in the parallel machine under consideration can operate are described in the article. Author (TAB)

N68-30755# System Development Corp., Santa Monica, Calif.
ON-LINE INFORMATION RETRIEVAL USING ASSOCIATIVE INDEXING Final Report
Harold Borko, Donald A. Blankenship, and Robert C. Burket Griffiss AFB, N. Y. RADC May 1968 133 p refs
(Contract F30602-67-C-0077)
(TM-(L)-3851; RADC-TR-68-100; AD-670195)

Experiments were performed to determine the feasibility of using ALCAPP as one form of on-line dialogue. Assuming the ALCAPP (Automatic List Classification and Profile Production) system is in an on-line mode, investigations of those parameters which could affect its stability and reliability were conducted. Fifty-two full text documents were used to test how type of indexing, depth of indexing, the classification algorithm, the order of document presentation, and the homogeneity of the document collection would affect the hierarchical grouping programs of ALCAPP. Six hundred abstracts were used to study the effect on document clusters when more documents are added to the data base and the effect on the final cluster arrangement when the initial assignment of documents to clusters is arbitrary. Results reveal that the only time significant differences in the classification of documents does not occur is when the order of document presentation is varied. Final clusters are significantly affected by the initial assignment of documents to clusters. The number of documents added to a data base allows stability of clusters only to a cutoff point which is some percentage of the original number of documents in the data base. Author (TAB)

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N68-29639# Florida Univ., Gainesville. Engineering Coll.
A CENTER OF COMPETENCE IN SOLID STATE MATERIALS AND DEVICES
Fred A. Lindholm, Arthur J. Brodersen, Eugene R. Chenette, Robert W. Gould, Larry L. Hench et al 10 Apr. 1968 99 p refs
(Contract F19628-68-C-0058; ARPA Order 1060)
(SR-1; AFCRL-68-0185; AD-669580)

The report, for the first semiannual period of contract support, describes technical findings concerned with glass-ceramic dielectrics, semiconducting glasses, electronic and structural properties of semiconductors, near-degenerate pn junctions, and radiation studies on materials. In addition to the reporting of these technical findings, major additions to our experimental capability made during this period are summarized. Two detailed reportings are made concerning structure in glass-ceramic dielectrics: one concerning the kinetics of crystallization, studied by quantitative x-ray diffraction, and the other concerning structural changes resulting from thermal treatment, studied by electron microscopy, x-ray analysis, and dc and ac electrical properties. For semiconducting glasses, correlations are made concerning thermal treatment and structural changes, on the one hand, and dielectric and electronic properties, on the other. Results are reported from two studies aimed toward determining the structure of compound and elemental semiconductors. An expression for the diffusivity-mobility ratio is derived that is valid for degenerate as well as non-degenerate semiconductors, and is used to plot this ratio against carrier concentration. Brief disclosure is made concerning the radiation stability of semiconducting glasses and insulating glass-ceramics. Author (TAB)

N68-29670# St. Louis Univ., Mo. Parks Coll. of Aeronautical Technology.
THE AIRCRAFT INTEGRATED DATA SYSTEM, ACIDS
J. F. Harrington, J. W. Bryer, J. A. George, R. R. Shank, and D. W. Carter Jun. 1968 246 p refs
(Contract DAAJ01-67-C-0733(G))
(USAAVCOM-TR-68-1; AD-669262)

The report describes a study conducted to determine the motion of the structure and foundation during antenna operation for the: (a) TAA-2A radar tower, Vero Beach, Florida, and (b) TAA-3 antenna, Merritt Island, Florida. Specifically, these tests determined the magnitude and direction of displacement, natural frequencies, phase of movement, and attenuation characteristics of the structure and foundation. These tests were performed using maximum programmed antenna accelerations, velocities, and decelerations, which were recorded for correlations. Motion in three planes--vertical, radial, and tangential--was monitored at different transducer locations by means of velocity-type pickups. Theoretical procedures described in EM 1110-345-310 were used to predict the frequencies and displacements that would occur. Author (TAB)

N68-29730# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A STABLE TRANSFORMERLESS LF AMPLIFIER [STABIL'NYY BESTRANSFORMATORNYY USILITEL'NCH]
I. Akulinichev 12 Jul. 1967 8 p Transl. into ENGLISH from Radio (Moscow), no. 4, 1967 p 1-28
(FTD-HT-23-945-67; AD-669522)

The article describes a transformerless LF amplifier which the author considers highly reliable, having tested it for two years as an amplifier in a television set. Necessary circuitry is described. An evaluation of the amplifier is appended. TAB

N68-29738# Stevens Inst. of Tech., Hoboken, N. J. Davidson Lab.
FABRICATION OF DIELECTRIC SWITCH ELEMENTS Final Report
George W. Zepko Dec. 1967 20 p
(Contract DA-18-001-AMC-932(X))
(Rept.-1219; AD-669622)

The report describes the steps to be taken in the fabrication of switch elements for a solid-dielectric low-inductance switch which can be used in high-energy discharge circuits. The elements are used in a type of switch having an inductance of 1 x 10 to the minus 9th power H, current carrying capability of 1000,000, and switch delay time of from 0.1 to 0.0000003 sec. Switches of this kind have been used at 15 kV and higher, with a low-inductance capacitor bank. Author (TAB)

N68-29777# Syracuse Univ., N. Y. Dept. of Electrical Engineering.
HETEROJUNCTION DEVICES Final Report, Dec. 1964-Dec. 1967
Richard L. Anderson, G. Zeidenbergs, and Mark Davis Griffiss AFB, N. Y. RADC Mar. 1968 85 p refs
(Contract AF 30(602)-3637)
(RADC-TR-68-70; AD-669365)

Sections I and II describe work done during the past year on the GaAs GaP heterojunction system. An open tube epitaxy system with HCl as a carrier gas was used to deposit GaAs upon GaP. From the deposits n-n, n-p and p-n GaAs-GaP heterojunctions were constructed. The electrical and optical properties were studied to determine the energy band profiles and approximate models for the current carrying mechanisms. Section III covers experimental work which was carried out on n-p Si-GaP heterojunctions to demonstrate explicitly the existence of inversion layers and study the feasibility of a field effect device. Section IV summarizes the work done over the whole three year contract span. Author (TAB)

N68-29823# Naval Avionics Facility, Indianapolis, Ind.
ENGINEERING EVALUATION OF NAFI STANDARD HARDWARE MODULES Final Report
Timothy Smith 30 Nov. 1967 71 p
(NAFI-TR-1094; AD-669460)

Twenty-six NAFI Type 3 Standard Hardware (SHP) Modules, mounted in a NAFI plug-in module mounting fixture were subjected to engineering evaluation tests. The back panel wiring of the module assembly, specifically the wire wrap connections, was also evaluated. The environmental tests included: temperature, thermal shock, salt fog, and humidity. TAB

N68-29859 IIT Research Inst., Chicago, Ill.
CHARACTERIZATION OF THE JUNCTION GATE FIELD-EFFECT TRANSISTOR
John Campbell Sinclair (Ph.D. Thesis) 1967 131 p

An analytic characterization is presented of the junction gate field-effect transistor particularly as it applies to audio-frequency low-supply voltage utilization. The currently available theory is extended to predict accurately the output current-voltage characteristics for any values of gate-to-source and drain-to-source voltage. To verify the theory experimentally six widely different field-effect transistors are selected. The data for each of these transistors is force fitted to the theory at one point only; the resulting correlation between theory and measurement is excellent.

It is shown that when cast in a different form, the equations can be more easily manipulated mathematically and applications more easily derived. The new form of the equations is rigorously developed. In addition to pinch-off voltage and drain current one additional specification is shown to be required, i.e., the drain current at one volt drain-to-source voltage with the gate shorted to the source. Using these final equations, every point on the calculated characteristics is within five per cent of the measured values. Dissert. Abstr.

N68-29890*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
METHODS OF ESTIMATING THE ECONOMIC EFFECTIVENESS OF INCREASED RELIABILITY OF RADIOELECTRONIC SYSTEMS
V. G. Krivoruchenko and L. B. Sul'povar Redstone Arsenal, Ala. Redstone Sci. Inform. Center 18 Apr. 1968 21 p refs Transl. into ENGLISH from Standarty i Kachestvo (USSR), v. 8, 1966 p 49–54 Prepared for Army Missile Command
(NASA-TM-X-61022; RSIC-785) CFSTI: HC $3.00/MF $0.65
CSCL 14D

Cost calculation methods of projected radio electronic systems used for automation and control of production processes are described. Two methods of improving the reliability (improving the quality of the components and optimal reservation) are given, and their economic expediency is determined. Author

N68-29914*# MITHRAS, Inc., Cambridge, Mass.
FAST RESPONSE SILICON PHOTOCONDUCTIVE DETECTORS Final Report, 15 Jan.–15 Jun. 1967
Mark Douma 15 Jun. 1967 56 p
(Contract NAS12-523)
(NASA-CR-86069; MC-67-264-R1) CFSTI: HC $3.00/MF $0.65
CSCL 20F

The response time of a silicon photoconductive detector in a circuit containing capacitance depends on the recombination time of the photo-generated carriers and the RC response time of the circuit. This RC response time is a function of the impedance of the detector. A linear model is developed which gives the response of the detector in the circuit to square light pulses of arbitrary duration. It is found that the maximum signal can occur at times much longer than the end of the pulse and that for short pulses the signal is proportional to the energy in the pulse. The model and the expected reduction in RC response time using low impedance detectors is verified experimentally. Results are used to determine the responsivity. It is also found that the carrier recombination in these detectors varies inversely with the field under high field conditions (greater than about 100 volts/cm). A minimum carrier response time of 30 nanoseconds is obtained. Possible mechanisms for this effect are discussed. Author

N68-29960# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MEMORY DEVICE WITH EXTERNAL SELECTION [ZAPOMINAYUSHCHEYE USTROYSTVO S VNESHNIM VYBOROM]
V. N. Sorokin and N. P. Vashkevich 13 Sep. 1967 11 p refs Transl. into ENGLISH from Vychislitel'naya Tekhn. (Moscow), no. 5, 1966 p 51–57
(FTD-MT-24-130-67; AD-669300)

A highly reliable transistorized two-cores-per-bit file memory designed to operate in data processing control systems is described. It consists of: a ferrite-core stack serving as the accumulator store; two address registers; a sampling circuit; a circuit for generating sampling-current pulses; write drivers serving to shape powerful current pulses during data recording; an output signal amplifier; input and output registers; an overwriting circuit; and the operating-cycle control circuit. There are two cores per bit: a memory core and a switch core. The maximum switch time of any core does not exceed 4 msec. The memory device is powered from a 24 v source. The power requirement of the entire device is about 100 w. TAB

N68-29998# Army Electronics Labs., Fort Monmouth, N. J.
FREQUENCY ACCURACY OF THE BARIUM OXIDE BEAM TUBE
H. Hellwig Jan. 1968 25 p refs
(ECOM-2935; AD-669259)

A theoretical treatment of the properties of the barium oxide molecular beam tube in terms of its frequency precision is presented. Numerical results for a given beam tube design are derived. The influence of magnetic and electric fields, the Doppler effect, cavity pulling, and the exciting R. F. spectrum are discussed. The results are summarized by stating the requirements for a frequency accuracy of better than 10 to the -12th power with respect to the natural molecular transition frequency. Such a beam tube seems feasible and capable of operating unshielded in magnetic environments of several hundred Gauss. Author (TAB)

N68-30027# Cinch Mfg. Co., Chicago, Ill.
PRINTED CIRCUIT CONNECTORS FOR MICROASSEMBLIES Final Report, 1 Jan. 1965–3 May 1967
Howard E. Dwan Feb. 1968 113 p
(Contract DA-28-043-AMC-00294(E))
(ECOM-00294-F; Rept.-2; AD-669256)

The report documents the research and development effort of a program for the study of four microassembly connector designs. These connector designs are (1) receptacle for the hermetic sealed micro circuit module (MCM), (2) encapsulated MCM header and receptacle-36 contacts, (3) encapsulated MCM header and receptacle-80 contacts, and (4) MCM microwafer test socket. The development and evaluation of these four connector designs are documented in this report. Included are design drawings and a summary of the test results. A receptacle design for the twenty pin MCM was fabricated using production type tooling and was demonstrated to be suitable for military equipments. A unique test socket for the testing of MCM microwafers was also designed, fabricated and demonstrated to meet the full requirements of the program. Models of the 36 and 80 contact MCM header and receptacle connectors fabricated using production type tooling did not meet the specified requirements. The primary problem with these connectors was concluded to be the variation inherent in raw contact material and the difficulty to control fabrication of the minute contacts required for the application. Author (TAB)

N68-30049# Commissariat a l'Energie Atomique, Saclay (France). Center d'Etudes Nucleaires.
ANALYSIS OF ELECTRONIC CIRCUITS USING DIGITAL COMPUTERS [L'ANALYSE DES CIRCUITS ELECTRONIQUES PAR LES CALCULATEURS NUMERIQUES]
Cornel Tapu Mar. 1968 48 p refs In FRENCH; ENGLISH summary
(CEA-R-3466) CFSTI: HC $3.00/MF $0.65

Various programs have been proposed for studying electronic circuits with the help of computers. It is shown here how it is possible to use the ECAP program, developed by IBM, for studying the behavior of an operational amplifier from different points of view: direct current, alternating current and transient state analysis, optimization of the gain in open loop, and study of the reliability. Author (ESRO)

N68-30061 Illinois Univ., Chicago.
EXPERIMENTAL INVESTIGATIONS OF THE ELECTRONIC PROPERTIES OF THE OXIDIZED SILICON SURFACE USING MOS CAPACITORS

Dean Robert Collins (Ph.D. Thesis) 1967 94 p
Available from Univ. Microfilms: HC $4.80/MF $3.00 Order No. 67-11833

Uniform, stable, and reproducible MOS capacitors were fabricated for the study of the electronic properties of the oxidized silicon surface. The following results were obtained. X-rays cause a positive effective surface state charge located near the $Si-SiO_2$ interface. The damage caused by the X-rays resulted in localized surface states and bulk silicon conversion. The effective surface state charge is stable at room temperature while the localized surface states and the bulk conversion are not. The introduction of gold into the devices causes a negative effective surface state charge. The gold diffuses through the silicon and appears to accumulate at the $Si-SiO_2$ interface. The surface state density is a complicated function of process parameters. The non-gold doped devices produced had a surface state density which was continuous across the forbidden band gap. A low and a high frequency capacitance theory including the bulk effects of gold was derived in order to analyse the gold doped devices. The effect of gold on the input impedance of a MOS capacitor was measured as a function of frequency and temperature. Estimates of the capture cross sections of gold in silicon was made using this theoretical calculation. Dissert. Abstr.

N68-30071# Army Electronics Lab., Fort Monmouth, N. J.
AGING OF COLDWELD-SEALED QUARTZ CRYSTAL UNITS
Joseph M. Stanley Feb. 1968 34 p refs
(ECOM-2946; AD-669592)

Design considerations for making reliable military coldweld holders are reviewed along with information on precautions to be taken for achieving reliable seals. Data is presented to show the improvement in aging of coldwelded general-purpose military crystal units over similar units in glass- and solder-sealed metal holders. Similarly, comparison of the aging of miniature crystal units in coldwelded HC-18/U and TO-5 military type holders shows the substantially improved performance of the units in the TO-5 type. The results of aging tests made on SSB crystal units in various metal coldweld holder configurations are reviewed and compared with similar units in glass holders. The two to one improvement in the aging of the coldwelded units is indicated to be due in part to the coldweld method of sealing but mainly to vacuum baking and coldweld sealing in the same high-vacuum environment. Data is also shown to indicate the effect of the bonding agent and holder configuration on the frequency-time stability of coldweld SSB crystal units. Single sideband crystal units in coldwelded HC-6/U holders are shown to be more stable than those in other metal holder configurations. Their average weekly aging rate indicates that the average frequency change in a 20,000-hour reliability period would be 12 x 10 to the minus 8th power. Author (TAB)

N68-30089# Hewlett-Packard Co., Palo Alto, Calif.
INVESTIGATION OF SEMICONDUCTOR SCHOTTKY BARRIERS FOR OPTICAL DETECTION AND CATHODE EMISSION
Robert J. Archer, Jerome Cohen, and Jueri Vilms Mar. 1968 51 p refs
(Contract F19628-68-C-0090)
(AFCRL-68-0122; SR-1; AD-670183)

A study was made of metal-semiconductor contacts, with dual emphasis on infra-red optical detection and on cathodic emission. A layered optical matching structure for increasing the efficiency of metal-semiconductor photoemissive detectors has been designed in theory. An initial experimental structure has shown sixfold efficiency improvement near 0.975 eV photon energy over a detector of conventional design. An anomalously high photoemissive yield has been observed for small-area diodes. Optical and cryogenic apparatus has been designed to permit extension of experimental work to 6 mu wavelength. A practical cathodic emission vehicle has been developed utilizing the Ag-GaP Schottky barrier. Au- and Ag-ZnS diodes have been found to have a 1.83 eV barrier height for a chemically prepared ZnS surface. Author (TAB)

N68-30104# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
HARMONIC ANALYZER FOR MEASURING FIRST AND SECOND DERIVATIVES OF 1-5 CHARACTERISTICS OF TUNNEL DIODES AND POINT-CONTACT DIODES
Yuan-hua Hsu 25 Aug. 1967 19 p refs Transl. into ENGLISH from Wu Li Hsueh Pao (Peking), v. 20, no. 9, 1964 p 919-926
(FTD-HT-66-507; AD-669514)

An instrument for measuring the first and second derivatives of I-V characteristics of tunnel diodes and point contact diodes as a function of D.C. bias was designed. The principle of operation is based on the harmonic analysis of the current. The circuit involved is rather simple. As an example for the application of this instrument, plots of first and second derivatives of a tunnel diode and a point contact diode were shown. From the given results, it was pointed out that tunnel diodes may be used in low level detectors. Author (TAB)

N68-30153# Aeronautical Research Council (Gt. Brit.).
A SURVEY OF THE THERMAL CONDUCTANCE OF METALLIC CONTACTS
H. Y. Wong 1968 39 p refs Supersedes ARC-26715
(ARC-CP-973; PD-3605; ARC-26715; AD-833463)

Based on a literature survey, experimental and theoretical data are presented on the engineering problems associated with thermal contact conductance. In discussing the mechanism of contact heat transfer, three modes are considered: heat transfer by conduction through actual contact, through interfacial gas (if the fluid is a gas), and by direct radiation. Formulas are presented for calculating the contact area, the constriction resistance, and the surface roughness, and the factors affecting the thermal conductance of a contact joint are examined in terms of the surface films, applied pressure, increasing temperature, and heating time. Consideration is also given to the characteristics of contact joints subjected to transient heating, thermal contact at low temperatures, and heat transfer at the interface of dissimilar metals. Hysteresis phenomenon is discussed, and techniques for improving contact conductance are reported. A report bibliography is included. M.G.J.

N68-30214*# Techtran Corp., Glen Burnie, Md.
CONTACT RESISTANCE IN SILICON CARBIDE CONTACTS
Masaharu Namba Washington NASA Jun. 1968 13 p refs Transl. into ENGLISH from Oyo Butsuri (Tokyo), v. 26, no. 11, 1957 p 602-608
(Contract NASw-1695)
(NASA-TT-F-11736) CFSTI: HC $3.00/MF $0.65 CSCL 09A

Referring to metal-and SiC-SiC contact characteristics, potential energy of an electron in SiC surface is discussed and volt-ampere characteristics of SiC-SiC contact are derived for which the existence of both space charge and oxide layer is considered. In order to avoid the tunnelling mechanism of the current flow, assumptions are made that the potential of the latter is nearly equal to that of the former, ϕ_0, and the motion of the electron through these barriers is described by diffusion theory. Author

N68-30230# Air Force Systems Command, Wright-Patterson AFB, Ohio. Air Force Avionics Lab.
INTERNAL PHOTOEMISSION IN EVAPORATED ALUMINUM-ALUMINUM OXIDE-ALUMINUM THIN FILM DEVICES

Julian A. Crawford, (Systems Res. Labs., Inc.), Kenneth D. O'Dell (Systems Res. Lab., Inc.), and Fritz L. Schuermeyer Mar. 1968 27 p Presented at the Am. Phys. Soc. Meeting, Minneapolis, Jun. 1966 Prepared jointly with Systems Res. Labs., Inc., Dayton, Ohio
(Contract AF 33(657)-11542)
(AFAL-TR-67-347; AD-669331)

The results of a study of internal photoemission in evaporated Al-Al2O3-Al thin-film sandwiches will be presented. The dielectric films for these samples were prepared by electron-beam evaporation from a sapphire rod. This material has a dielectric constant of about 7.5. Film thicknesses were measured capacitively, interferrometrically, and with a quartz-crystal-oscillator microbalance all of which gave internally consistent results. The photoresponse was measured at room temperature as a function of wavelength at different bias voltages for dielectric films ranging in thickness from about 100 A to less than 40 A. The results, interpreted in terms of metal-insulator barrier height, indicate that the barrier shape is trapezoidal but that the asymmetry decreases abruptly for dielectric thicknesses below about 60 A. The zero-bias barrier height was found to be 1.8 eV for the 42-A films, and it increased rapidly with dielectric thickness. These results will be discussed in terms of the current theories of metal-insulator-metal thin-film devices. Author (TAB)

N68-30320# International Business Machines Corp., Hopewell Junction, N. Y. East Fishkill Facility.
SEMICONDUCTOR JUNCTION PROPERTIES AS INFLUENCED BY CRYSTALLOGRAPHIC IMPERFECTIONS Final Report, 15 Feb. 1965 – 15 Feb. 1968
Guenter H. Schwuttke Mar. 1968 25 p refs
(Contract AF 19 (628)-5059)
(IBM-TR-22-613; AFCRL-68-0175; AD-669335)

A short summary of the major results of semiconductor junction properties as influenced by crystallographic imperfections. Reference is made to the previous technical reports and scientific publications in which detailed discussion of the various phenomena is presented. Author (TAB)

N68-30371# Polytechnic Inst. of Brooklyn, Farmingdale, N. Y.
SYNTHESIS OF LUMPED N-PORTS VIA REACTANCE EXTRACTION
Pinio Tissi Griffiss AFB, N. Y. RADC May 1968 113 p refs
(Contract AF 30(602)-3951)
(PIBMRI-1370-67; RADC-TR-67-668; AD-669820)

The synthesis of lumped passive n-ports is presented under a new point of view. The initial datum is a bounded-real rational matrix S(p), representing a scattering matrix description of an n-port. When all reactances are removed, with the concurrent creation of additional ports, the residual network is frequency-independent. A description of this residual network can be obtained, and special techniques are developed for this purpose. In particular, the case is treated when the synthesis employs the minimum number of reactances. A new characterization of this number is presented, as the rank of a constant Hankel matrix. The problem of equivalence is treated as the description of all residual networks. Next, the nonminimal synthesis is considered, and finally, some results are presented on the synthesis of non-reciprocal networks, with the minimum number of gyrators. Author (TAB)

N68-30390# Institute Franco-Allemand de Recherches, St. Louis (France).
DYNAMIC CALIBRATION CURVES OF HIGH PRESSURE PICK-OFFS [COURBES D'ETALONNAGE EN DYNAMIQUE DE CAPTEURS HAUTES PRESSIONS]
F. Valentin 31 May 1967 24 p In FRENCH
(T-17/67) CFSTI: HC $3.00/MF $0.65

Frequency response of different types of Kistler and Bross high pressure piezoelectric pick-offs was measured at 0 to 10,000 atm. Differences in calibration curves for pickoffs of the same series were attributed to differences in sensitivity to acceleration vibration. In most cases it was not possible to totally eliminate the vibrations, although insensitivity to acceleration results in atmospheres of less than 10^{-4} atm. Both linear and logarithmic curves are presented for each of the pick-off types. Transl. by M.W.R.

N68-30410# International Business Machines Corp., Owego, N. Y. Electronics Systems Center.
ANALYSIS OF RADIATION-INDUCED COUPLING EFFECTS BETWEEN INTEGRATED CIRCUIT ELEMENTS Final Report, 12 May 1967 – 28 Feb. 1968
F. Frankovsky, H. Protschka, G. Boyd, and P. Boczar 28 Feb. 1968 80 p refs
(Contract F19628-67-C-0308)
(IBM-68-521; AFCRL-68-0200; AD-669852)

The report describes the investigation of the dielectric isolation of an integrated circuit while under electron irradiation by studying the two primary effects of induced transient conductivity and charge storage in silicon dioxide layers. A mathematical approximation describing physical processes, outlined in a qualitative physical model, was developed which consists of a set of partial differential equations. A combined set of differential and difference equations have been constructed and solutions for these equations were found by using SCEPTREs differential equation solution capability. This computer program calculates transient conductivity, field distributions and the charges in the dielectric before and after irradiation. The average internal electric field in the silicon dioxide layer of SOS-structures was measured by means of optical probing with a Helium-Neon laser utilizing the electro-optical Kerr effect. For an unirradiated structure the average field in the oxide at zero bias was determined as 4 x 40,000 V/cm. In an identical SOS-structure electron bombarded with a total dose of 5.5 x 4,000 rads an average field of 1.2 x 120,000 V/cm was measured corresponding to 2.6 x 10 to the 12th power charges per sq cm in the dielectric. It could be concluded that the field in the dielectric at zero bias is directed toward the polysilicon layer. Positive charges stored in the dielectric are located in the vicinity of the interface silicon dioxide single crystal silicon. Author (TAB)

N68-30439# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A SIMPLIFIED METHOD OF DESIGN FOR A CLASS OF HIGH-POWER MICROWAVE FILTERS
Lin Kang 31 Aug. 1967 19 p refs Transl. into ENGLISH from Tien Tzu Hsueh Pao (Communist China), no. 2, 1963 p 75–84
(FTD-HT-67-238; AD-670278)

A simple equivalent circuit is established for the taper section of a class of a high-power microwave filter consisting of taper sections of radial lines and sections of uniform line. A simplified design of this class of filter was developed by making use of the equivalent circuit. TAB

N68-30449# Naval Avionics Facility, Indianapolis, Ind.
EVALUATION OF INITIAL PROTECT PILOT STUDY
Bruce R. Glenn 15 Dec. 1967 24 p refs
(NAFI-TR-1124; AD-669904)

The report contains the results of an initial ten month pilot study of PROTECT (Probabilistic Recall Optimizing the Employment of Calibration Time). Included is information on the classes of test equipments used and problems involved in the study. The results are presented in tables and graphs and conclusions are drawn from these results. Author (TAB)

N68-30501*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.

ON ELECTROMAGNETIC SWITCHING PROPERTIES OF A BI-STABLE FLUIDIC ELEMENT WITH NON-DESTRUCTIVE MEMORY

Joseph S. Koziol, Jr. and Robert De Furia Washington Aug. 1968 39 p refs

(NASA-TM-X-1613) CFSTI: HC$3.00/MF$0.65 CSCL 09E

The feasibility is discussed of controlling a magnetically permeable liquid bead with an electromagnet between two stable states of a particular system. Several useful properties of the switching system, namely, magnetomotive force required for switching, switching time, and ambient acceleration field limits are determined in terms of the system parameters. This concept suggests a simple, bi-stable, low-power, electric-to-fluid transducer with non-destructive memory. (The fluid bead retains its last stable state with all power off.) Development of a magnetically permeable liquid with high surface tension did not reach the stage for implementation, at the completion of the analysis, to permit experimental verification of the analytical results contained herein. Author

N68-30507# California Univ., Berkeley. Electronics Research Lab.

ELECTROMAGNETIC WAVE-CHARGE INTERACTION IN CROSSED FIELDS Quarterly Progress Report, 16 Nov. 1967–15 Feb. 1968

K. A. Fox, M. A. Myer, S. Swierkowski, C. W. Turner, T. Van Duzer et al May 1968 34 p refs

(Contract DAAB07-67-C-0227)

(ECOM-0227-3; OSD-1366; QPR-3; Rept.-3; AD-670055)

The purpose of the work on this contract is to investigate the interaction of electromagnetic waves and charge carriers in vacuum and solids. The construction of a crossed-field amplifier which will incorporate the results of our noise studies is in progress. Evaluation of the interaction impedance of the flattened helix from measurements of perturbations of the resonant frequency of a shorting-plane cavity is being made. The paraxial crossed-field gun design method is being carried on to obtain designs for magnetically shielded guns. We are looking at ways of reaching the optimum compromise between desirable potentials and convergence. An experimental and theoretical evaluation of the crossed-field acoustic-wave amplifier is being conducted. In this quarter a computer program was developed to evaluate the maximum gain per unit length obtainable as a function of frequency with a limitation set on allowable power dissipation per unit volume. Electromagnetic and space-charge waves in semiconductors are being studied in order to determine if there are microwave device applications. The effort during this quarter was devoted to developing efficient means for interacting with the space-charge waves with energy from an external source. Author (TAB)

N68-30607# Eidgenossische Technische Hochschule, Zurich (Switzerland).

INVESTIGATIONS OF SWITCH-OFF PERFORMANCE OF THREE-PLY DIODES [UNTERSUCHUNGEN UEBER DIE ABSCHALTVORGAENGE BEI DREISCHICHTDIODEN]

Karl Wenz (Ph.D. Thesis) 1967 237 p refs In GERMAN *Its* Dissertation No. 4024

CFSTI: HC$3.00/MF$0.65

In order to determine accurately the behavior of psn-diodes and thyristors in high current circuits, it is necessary to study the turn-off properties of the devices. The basic charge equation is derived relating the stored charge to the device current. From measurements it is seen how the charge equation is to be modified in order to calculate the recovery interval for a pan-diode when using trapezoidal or square-wave commutation. It is also shown that, for diodes and thyristors, a large overvoltage occurs following every zero passage of the device current. In order to calculate the form of the overvoltage peaks, the static, non-linear dependence of the junction capacity on applied voltage is used. An equivalent circuit for the calculation of the transient behaviour of psn-diodes is derived. As an application of this equivalent circuit the turn-off-oscillation of a psn-diode is calculated. The last section is devoted to technical applications. A simple method is given for determining the dynamic reverse current in commutating circuits. Author

N68-30636# Battelle Memorial Inst., Columbus, Ohio.

PRESSURE-TEMPERATURE EFFECTS ON CHARGE-TRANSPORT IN TRANSITION-METAL OXIDES Final Report

Arthur P. Young, P. J. Freud, and C. M. Schwartz 24 May 1968 13 p refs

(Grant AF-AFOSR-263-65)

(AFOSR-68-0982; AD-669831)

Effects of pressure and temperature on electrical conductivity and thermoelectric power of NiO, CoO, Fe2O3, and Cu2O were measured. The temperature dependence of conductivity and Seebeck coefficient in lithium doped NiO and CoO single crystals indicated that hole mobility was thermally activated with an activation energy of 0.1 ev. Hopping type transport appeared likely in these materials. The temperature dependence of electrical properties on pressure compacted titanium doped Fe2O3 also indicated that electron mobility was thermally activated. Electrical conductivity of Cu2O single crystals increased exponentially with temperature in the 300K to 500K range. The activation energy was 0.26 ev. The Seebeck coefficient was nearly constant, about 1 mv/deg. C from 300K to 500K. Hopping transport is a diffusion process and may have an associated heat of transport. If the heat of transport is not nearly zero, the usual equations for charge concentration and mobility in terms of resistivity and thermoelectric power are not correct. It can be shown that according to the Holstein hopping model the heat of transport should be nearly zero. Conclusions about charge carrier mobility from resistivity and thermoelectric power measurements should be nearly correct. Author (TAB)

N68-30639# ITT Semiconductors Products Labs., Palo Alto, Calif.

FOUR LAYER DIODE DEVELOPMENT PROGRAM Final Report

Robert M. Scarlett Apr. 1968 74 p refs

(Contract AF 30(602)-4045)

This effort is the culmination of several years work to improve and demonstrate the four-layer diode in high power switch service. The fabrication of the device, its characteristics and an evaluation of performance of the device in a high voltage high current environment is discussed. Several device problems became evident during this effort and are characterized in the text. The failure rates, thermal dissipation problems, voltage distribution, repetition rate limitations and general device behavior are thoroughly discussed. Author (TAB)

N68-30662# Eidgenossische Technische Hochschule, Zurich (Switzerland).

OFFSET GATE FIELD EFFECT TRANSISTORS WITH HIGH DRAIN BREAKDOWN POTENTIAL AND LOW MILLER FEEDBACK CAPACITANCE

Hans G. Dill (Ph.D. Thesis) 1967 141 p refs *Its* Dissertation No. 4023

CFSTI: HC$3.00/MF$0.65

The development of two new offset gate IGFET's (insulated gate field effect transistors) is reported. Described are the insulated gate tetrode (IGT) which utilizes a second stacked gate to induce the offset channel, and the insulated gate off-set transistor (IGOST) in which the offset channel is produced with ion implantation. Primary advantages of these devices are better stability, availability of P an N channel devices, and the possibility of optimizing the

device performance, i.e., the drain breakdown potential. Considered are design and fabrication problems, V-I characteristics; drain breakdown potential, dynamic drain resistance, small signal equivalent circuit, large signal limitations, and 1/f noise. S.C.W.

N68-30675# Radio Corp. of America, Princeton, N. J. David Sarnoff Research Lab.
LOW TEMPERATURE INFRARED PHOTOCONDUCTORS
Semiannual Report, 1 Jul.–31 Dec. 1967
Melvin L. Schultz 29 May 1968 33 p refs
(Contract Nonr-2225(00))
(AD-670009)

Research directed toward the development of an infrared sensitive solid state photoconductive multiplier is reported. The possibility of the use of amorphous Se as the insulator layer together with PbTe as the photoconductor for the multiplier has been investigated. The transport properties of this combination have been found to be rather irreproducible. Evidence is presented which suggests that the source of the difficulty is the conversion, at room temperature, of amorphous Se to the hexagonal crystalline state. This conversion appears to be catalyzed by contact between the amorphous Se and crystalline PbTe or PbSe. Because of this, amorphous Se is unsuitable as the insulator layer if the photoconductor is to be a lead chalcogenide. Author (TAB)

N68-30680# Army Electronics Labs., Fort Monmouth, N. J.
STATUS OF DIFFUSION DATA FOR BINARY COMPOUND SEMICONDUCTORS
David W. Yarbrough Mar. 1968 69 p refs
(ECOM-2942; AD-670014)

A survey of the literature was completed in an effort to establish the status of diffusion data in III-V compounds, II-VI compounds, and SiC. This report will be useful in providing a relatively complete review and bibliography of published diffusion data. An effort was made to indicate those species which exhibit non-fickian behavior. In many cases, diffusion data are correlated in terms of concentration dependent diffusion coefficients. For those species indicating fickian behavior over some range of temperature or concentration the important temperature variation parameters are given. Author (TAB)

N68-30692# Applied Physics Lab., John Hopkins Univ., Silver Spring, Md.
THE FRENKEL EFFECT IN SEMICONDUCTOR DIODES
V. I. Gaman 15 Mar. 1968 11 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Fiz. (Tomsk), no. 9, 1967 p 92–98
(Contract NOw-62-0604)
(APL-TG-230-T550; AD-669936)

One of the possible alternate ways is chosen to explain the voltage-dependence of reverse current observed experimentally under certain conditions in germanium and silicon diodes. The explanation is based on the assumption that in the volume charge regions of a p-n junction the probability of generating electrons and holes by recombination centers is increased with reverse voltage because thermal ionization is facilitated by the electric field. Author (TAB)

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories.

N68-29657 Oregon State Univ., Corvallis.
A METHOD OF SEPARATION OF EXPONENTIALS AND ITS RELATIONSHIP TO TIME DOMAIN SYNTHESIS OF A FINE LUMPED-PARAMETER RELAXATION SYSTEM
Sommai Vongsuri (Ph.D. Thesis) 1967 66 p
Available from Univ. Microfilms: HC $3.80/MF $3.00 Order No. 67-11533

The general mathematical theory of linear passive one-ports and the class of positive real functions are briefly reviewed as background material. A time domain method for synthesis of a finite lumped RC system is given, which involves breaking down the given system into n sub-systems. Finally, it is shown that one method of separation of a finite number of exponentials from a given completely monotonic curve over a finite interval is related to the above mentioned method of time domain synthesis. Here the given curve is treated as the impulse response of a finite lumped RC system. It is shown that the parameters being sought are related to the eigenvalues of the system matrix and the first components of the orthonormal eigenvectors corresponding to those eigenvalues, and it is proved that the system matrix has distinct positive eigenvalues. Dissert. Abstr.

N68-29689# New York Univ., N. Y. Electrical Engineering Dept.
NETWORK FUNCTION SYNTHESIS USING NON-IDEAL GROUNDED AMPLIFIERS AND RC ONE-PORTS
Murray Goldman and Mohammed S. Ghausi Dec. 1967 52 p refs
(Contract AF 19(628)-5537)
(TR-400-174; AFCRL-68-0111; SR-9; AD-669374)

A configuration containing 3 practical grounded amplifiers and passive RC one-ports which is capable of synthesizing any general lumped network function is derived. The network function specification can be in the form of a driving-point immittance function or any of the four forms of transfer functions. Non ideal controlled source models and the source and load impedances are explicitly included in the configuration, thus making its usage especially attractive from a practical viewpoint. Of particular interest is that complete compensation for the poles of the high gain amplifiers is achieved in the synthesis procedure. Thus one can obtain high gains with practical element values without loss of bandwidth. Author (TAB)

N68-29731 Case Inst. of Tech., Cleveland, Ohio.
OPTIMAL TIME-DOMAIN SYNTHESIS OF LINEAR NETWORKS
Ionnis A. Athanassopoulos (Ph.D. Thesis) 1968 142 p
Available from Univ. Microfilms: HC $6.80/MF $3.00 Order No. 67-11541

The time-domain synthesis of electrical network with bounded elements is formulated as a nonlinear programming problem. By using a penalty-function approach, the solution of the nonlinear program is obtained by a sequence of unconstrained minimizations of a derived objective function. State and "state-sensitivity" differential equations are used in the description of the network dynamics and the computation of the partial derivatives of the output response with respect to the network element-values. The prescribed response is approximated in a constrained, discrete, Chebychev sense. The application to practical filter networks is illustrated by an example. Author

N68-29798 University of Southern Calif., Los Angeles.
ANALYSIS AND SYNTHESIS OF DISCRETE-TIME SYSTEMS WITH CONTROL SIGNALS OF VARIABLE AMPLITUDE AND PULSE-WIDTH
Louis Robert Nardizzi (Ph.D. Thesis) 1967 122 p
Available from Univ. Microfilms: HC $6.00/MF $3.00 Order No. 67-13036

In the past a great deal of attention has been given to discrete-time systems containing either pulse-width or pulse-amplitude modulators. This dissertation presents the analysis and synthesis of discrete-time systems containing control signals with both variable amplitude and pulse-width. In particular, the problem considered consists of a general class of open-loop control systems which are driven by modulators whose output signals have either variable amplitude, pulse-width or combinations thereof. The computational and engineering aspects of the necessary conditions are dealt with in order to compare various forms of modulation. A number of examples illustrate the diverse nature of the open-loop solutions for different types of modulation. Based upon these open-loop solutions, a method is proposed which generates an approximate solution to the closed-loop problem. In addition this dissertation provides a computer-oriented method for obtaining the sensitivity of the output of a system to variations of its input amplitude or pulse-width. Dissert. Abstr.

N68-29829
ON THE INVARIANCE OF COMPOSITE PULSE PROGRAM CONTROL SYSTEMS
L. S. Zhitetskii 1968 4 p refs Transl. into ENGLISH from Avtomatika (USSR), no. 6, 1967 p 83–85
CFSTI: HC $3.00/MF $0.65

By increasing shift between input and output signals and selecting the required compensator parameters, it is theoretically possible to decrease both the fixed and transient errors infinitely at discrete times for an arbitrary input signal. Invariance of composite pulse program control is discussed in this light, and a method is proposed for solving the problem in the case of the reduced continuous part having the property of non-minimal phasedness when compliance with the invariance conditions causes loss in compensator stability. A pulse transfer function is used to describe the reduced continuous part which is of non-minimum phase, and a discrete compensator formed directly from this is unstable. A two-sided z-transform is therefore, used to satisfy the stability requirements. M.W.R.

N68-29865# Royal Aircraft Establishment, Farnborough (England).
THEORETICAL AND COMPUTATIONAL ASPECTS OF OPTIMUM CONTROL
R. N. A. Plimmer Dec. 1967 29 p refs Presented at the Conf. of the Inst. of Math. and its Applications, Apr. 1968
(RAE-TR-67320; AD-833492)

This report considers some of the theoretical aspects of optimal control theory and various computational techniques which have been used to expedite a solution. By considering first of all, the classical Bolza problem arising in the calculus of variations and the conditions which are necessary for an optimum solution, it is shown how these are related to the Maximum Principle of Pontryagin and the method of dynamic programming. Several computational procedures are discussed including the methods of boundary iteration, steepest descent, second variation, generalised Newton–Raphson and dynamic programming. Author (TAB)

N68-29923 Pennsylvania Univ., Philadelphia.
VOLTERRA FUNCTIONAL ANALYSIS OF NONLINEAR SYSTEMS WITH DETERMINISTIC AND STOCHASTIC INPUTS
Chin-chun Su (Ph.D. Thesis) 1967 184 p
Available from Univ. Microfilms: HC $8.40/MF $3.00 Order No. 67-12810

The Volterra functional technique has proved particularly useful in connection with filtering, detection, and prediction problems as well as control problems. However, the use of the Volterra functional technique was, heretofore, limited to dealing with time-invariant nonlinear systems. In this research, the extension of this technique has been made to the analysis of time-varying nonlinear systems subject to deterministic and stochastic inputs. An explicit form for the representation of the output of time-varying systems is used so that a Fourier–Laplace transform and an algebra of the Volterra functional are established. An interesting aspect of the extension is that it suggests a unified and generalized representation of time-varying and time-invariant systems, linear or nonlinear; many familiar relationships in the time-invariant case can be carried over to the time-varying case. Multi-dimensional bifrequency system functions are introduced to characterize time-varying nonlinear systems; cascade theorems of time-varying linear and nonlinear systems are also presented. Dissert. Abstr.

N68-29939# Technische Hogeschool, Eindhoven (Netherlands).
A STUDY OF MAGNETIC-DEFLECTION ERRORS
Johannes Kaashoek (Ph.D. Thesis) 2 Jul. 1968 124 p refs
CFSTI: HC $3.00/MF $0.65

The errors introduced by the deflecting field on an electron beam in a cathode ray tube are investigated. An ideal deflection system is defined as one which produces a displacement of the spot on the screen proportional to the deflecting field strength while leaving the spot dimensions unchanged; practical deflection systems introduce unwanted deflection errors. Deflection error expressions are obtained with the Lagrange function of the deflection field. In the solution of electron path equations, first, second, third, and fifth order aberrations are considered. Magnetic field distribution is calculated for arbitrarily shaped air coils which, combined with field distribution parameters and error coefficients, indicate extent of deflection error reduction or avoidance. Design details of a deflector for a color television tube are given to illustrate practical application of the results of the deflection error theory. This approach also permits application of electronic computers in deflection system design. D.H.B.

N68-29940# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
RANDOM SEARCH IN OPTIMIZATION PROBLEMS FOR MULTIPARAMETER SYSTEMS
L. A. Rastrigin 1 Aug. 1967 263 p refs Transl. into ENGLISH of the book "Sluchaynnyy Poisk v Zadachakh Optimizatsii Mnogoparametricheskikh Sistem" Riga, Izd. Zinatne, 1965 p 1–211
(FTD-HT-67-363; AD-669542)

It is only quite recently, roughly from the middle Fifties, that the theory of multiparameter automatic-optimization systems has appeared and received vigorous development. The outstanding characteristic of such systems is the search process, which ensures production of the information required to control the object. The first studies in this area were carried out, and the principal ideas were formulated by Professor A.A. Feldbaum in 1956. In recent years, two trends have developed in the field of automatic-optimization system theory; they are characterized by different approaches to the nature of the search process. The first trend considers search as a fully regular process of information collection. Characteristic representatives of this trend are the very familiar Gauss-Seidel, gradient, steepest-descent, and other methods. The second trend originates with the Ashby Homeostat where the search process is random in nature, and the studies of A.G. Ivakhnenko, who demonstrated the importance of the randomness element for system selforganization. The present book is wholly concerned with the development of the latter trend, insofar as it applies to automatic optimization of multiparameter systems. TAB

N68-29942 Wisconsin Univ., Madison.
TOPOLOGICAL SYNTHESIS OF TRANSFORMERLESS PASSIVE ONE-PORT NETWORKS
Bahman Shahzadi (Ph.D. Thesis) 1967 138 p
Available from Univ. Microfilms: HC $6.60/MF $3.00 Order No. 67-9023

In this thesis all possible transformerless passive one-port networks (RLC) with various topology which possess a prescribed driving-point function and contain the minimum number of elements are investigated. Minimal RLC networks are defined and some of their properties are investigated. In particular, some relationships are established between the topology and the number of elements of minimal networks and the shape of their driving-point function. A technique for generating all minimal networks that can possibly realize a given driving-point function is established. The realization ability of minimal networks is also investigated. In particular, the canonic property of two-element kind networks is studied. The existence or non-existence of common factors in the driving-point function of two-element kind networks is investigated. And the role of common factors in the canonic property of networks is discussed in some detail. Dissert. Abstr.

N68-29946# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PROSPECTS OF DIGITAL CIRCUITS WORKING ON THE PRINCIPLE OF CURRENT DISTRIBUTION (PRT) WITH AN INCREASE OF THEIR HIGH SPEED OPERATION AND TEMPERATURE STABILITY [PERSPEKTIVY TSIFROVYKH SKHEM NA PRINTSIPE RASPREDELENIYA TOKA PRI POVYSHENII IKH BYSTRODEISTVIYA I TEMPERATURNOI USTOICHIVOSTI]
V. G. Kolosov, B. A. Milovidov, and N. I. Radomysl'skaya 11 Aug. 1968 18 p Transl. into ENGLISH from Tr. Leningr. Politekhn. Inst. (Moscow), no. 256, 1965 p 94–101
(FTD-MT-24-123-67; AD-669268)

The authors analyze theoretically the various types of circuits based on the principle of current distribution (PCD) and establish the basic pertinent relationships. Methods for circuit calculations (temperature dependence, maximum speed, minimum pulse duration, maximum frequency) of transistorized and ferrite-core containing units are developed and applied to a specific example of a standard fast, reliable unit and a PCD transmitting cell in four-cycle operation. This four-cycle cell operates with useful loads which are only one quarter of the load found under two-cycle operating conditions. This leads to a decrease in the number of triodes used, and the intensity of currents. The resulting digital elements are thus more reliable. TAB

N68-29999# Army Electronics Labs., Fort Monmouth, N. J.
DERIVATION OF SIGNAL-LEVEL CONSTRAINTS FOR A DIGITAL CIRCUIT Progress Report
William C. Cave Nov. 1967 28 p refs
(ECOM-2888; PR-2; AD-669235)

Generalized expressions of constraints on the signal levels of a digital circuit are derived. These constraints are expressed in terms of expected noise and element tolerances. A simplification of these constraints is provided based on the theory of envelopes. It is then demonstrated how these constraints can be transformed into constraints on the nominal circuit variables. Author (TAB)

N68-30010 North Carolina State Coll., Raleigh.
AN ALGORITHM FOR THE ITERATIVE SOLUTION OF A CLASS OF TWO-POINT BOUNDARY VALUE PROBLEMS OCCURRING IN OPTIMAL CONTROL THEORY
Ernest Stokes Armstrong, Jr. (Ph.D. Thesis) 1967 182 p
Available from Univ. Microfilms: HC $8.40/MF $3.00 Order No. 67-11972

In the work described herein, it is assumed that an indirect method has been applied to a controllable dynamic system with a two-point boundary value problem resulting such that the boundary conditions appear in the form where a set of unknown parameters is to be determined so that an equal number of known terminal conditions are met. In addition, the optimal control law is assumed to be a piecewise continuous function with discontinuities occurring only at the zeros of certain continuous functions termed "switching function." The use of such a control law introduces the possibility of a lack of differentiability in the dynamic equations at the points of discontinuity of the control function. Within this framework an algorithm is developed to improve upon an assumed set of parameters in such a way that, through repetitive use of the improvement procedure, a monotone decreasing sequence of values of a positive definite function that measures the terminal errors is produced. An additional advantage is that, if the final time is an unknown parameter, the final time correction is made an integral part of the process. This is, corrections in the final time are computed at each iteration as a component of the parameter correction vector. As an illustration the algorithm is applied to the determination of both time and fuel optimal trajectories involving a space vehicle which is assumed to be launched from the surface of the moon and required to rendezvous with a space station in a circular orbit. Dissert. Abstr.

N68-30034 Cornell Univ., Ithaca, N. Y.
STATE SPACE ANALYSIS OF THE DYNAMIC STABILITY OF SYNCHRONOUS MACHINES
Subramanian Natarajan (Ph.D. Thesis) 1967 139 p
Available from Univ. Microfilms: HC $6.60/MF $3.00 Order No. 67-12625

This work is an investigation of the dynamic stability of a voltage-regulated synchronous machine connected to an infinite bus through an external impedance. The state-variable formulation is used to express the incremental behavior of the system. A generalized expression from which a number of transfer functions pertinent to variables of perturbation can be obtained as particular cases is derived. A digital computer program examines dynamic stability at many equilibrium points and establishes limiting relationships that the system parameters must satisfy in order to insure stable operation in the steady state. The state equations and the computational routine are set up in general terms so that the influence of any of the system parameters, including per-unit load and power factor, may be investigated. This formulation yields the benefit of easy extension to various types of regulated systems. Modifications necessary to consider current regulation, angle regulation, or prime-mover torque control are developed. Dissert. Abstr.

N68-30073 IIT Research Inst., Chicago, Ill.
OPTIMAL CONTROL OF RETARDED SYSTEMS
Sudarshan Lal Uppal (Ph.D. Thesis) 1967 128 p
Available from Univ. Microfilms: HC $6.20/MF $3.00 Order No. 67-12581

In this paper, a numerical technique is described which can be used to obtain open loop and closed loop control laws for a system whose dynamics are represented by a linear constant-coefficient differential difference equation with a constant time delay. The cost function is assumed to be quadratic with fixed terminal time. When solving an optimization problem of this type by the maximum principle, a canonical system is obtained which is composed of n linear time lag differential equations of state variables, n linear time lead differential equations of costate variables and n linear ordinary differential equations of costate variables, subject to the usual split boundary conditions. A formulation has been obtained for determining the fundamental matrix to be used in the solution of the coupled lag and lead equations. The complete solution of these equations exists in the form of a generalized convolution integral. Dissert. Abstr.

N68-30099# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SUPPRESSING NATURAL OSCILLATIONS IN NONLINEAR COMBINED SYSTEMS [PODAVLENIE AVTOKOLEBANII V NELINEINYKH KOMBINIROVANNYKH SYSTEMAKH]

V. I. Panov 8 May 1967 22 p refs Transl. into ENGLISH from the book "Trudy Vtorogo Soveshchaniya po Teoriya Invariantnosti v Sistemakh Avtomaticheskogo Upravleniya" Moscow, 1964 p 255–264
(FTD-MT-24-102-67; AD-669429)

The suppression of auto-oscillations in nonlinear combined systems is investigated. An approximation method is proposed for estimating the effect of connections with respect to perturbation on the stability of nonlinear combined systems (NCS). This approximation method consists of two parts: a determination of the effects of connections with respect to perturbation on the effect of an open control circuit on the stability of the NCS, taking into account the specific nonlinear characteristic of the closed circuit. This article investigates single-circuit, nonlinear systems and those reduced to them, with one nonlinear link. Using the approximation method for determining the effect of connections with respect to perturbation on the stability of the NCS, the author concludes that the parameters of connections can be selected from the conditions of stability. The stability of NCS under different variants of including a connection with respect to perturbation can be determined. The effect of the parameters of links of a closed cycle on stability can also be determined. In addition, it is possible to fulfill the conditions of a given partial of absolute invariance in NCS. The author also points out that, if the nonlinear link of the system has a partial derivative greater than zero, the connections are a means of suppressing auto-oscillations. TAB

N68-30105# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SELF-ADJUSTING SYSTEM WITH NONLINEAR MODEL [SAMONASTRAIVAYUSHCHAYASYA SISTEMA S NELINEINOI MODELYU]
S. A. Babushkin 4 Aug. 1967 30 p refs Transl. into ENGLISH from Tr. Vses. Konf. po Teorii i Praktuke Samonastraivayushchikhsya Sistem, v. 1 (Moscow), Izd. Nauka, 1965 p 64–77
(FTD-MT-24-132-67; AD-669515)

Synthesis of the controller of a nonlinear adaptive system with outside disturbances is described. Control law equations are derived from the original state equations using variational methods. The variables are divided into two basic groups: directly observable and nonobservable. The latter are expressed as functions of the first. The problem of flight control of a variable mass body moving in the vicinity of Earth is considered as an example. A set of equations serving as the basis of the control law is derived and a block diagram of a special purpose computer to implement this control law is presented. TAB

N68-30133# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE CURRENT PRINCIPLE OF TRANSISTOR APPLICATION [TOKOVYI PRINTSIP ISPOLZOVANIYA TRANZISTORA]
I. Akulinichev 12 Jul. 1967 10 p ref Transl. into ENGLISH from Radio (Moscow), no. 10, 1966 p 54–55
(FTD-HT-23-946-67; AD-669426)

The author discusses transistors and points out what he considers errors in current circuits employing both pentodes and transistors. He also makes for the suggestions for other circuits suitable for transistors and describes modifications which he made to improve a television circuit. TAB

N68-30157 Arizona Univ., Tucson.
DESIGN OF NONLINEAR CONTROL SYSTEMS VIA STATE VARIABLE FEEDBACK
John Wesley Herring, Jr. (Ph.D. Thesis) 1967 119 p
Available from Univ. Microfilms: HC $5.80/MF $3.00 Order No. 67-11361

A method for designing closed loop control systems having a single, memoryless, nonlinear and/or time-varying gain with an input-output characteristic confined to the first and third quadrants is developed. Systems designed by the proposed method have the properties of absolute stability and bounded outputs for bounded inputs for any nonlinear gain of the type considered. Systems in which the gain is time-varying also have these properties if the time-varying gain is constrained to a finite sector in the first and third quadrants. The linear part of the open loop system can have no more than one integration, and all other poles must have negative real parts. In its basic form, the design method requires that the nonlinear and/or time-varying gain be located at the input end of the plant to be controlled. Dissert. Abstr.

N68-30242 California Univ., Berkeley.
INPUT–OUTPUT STABILITY OF CONTINUOUS AND DISCRETE TIME NONLINEAR CONTROL SYSTEMS
Ralph Peter Iwens (Ph.D. Thesis) 1967 257 p
Available from Univ. Microfilms: HC $11.70/MF $3.35 Order No. 67-11634

Sufficient conditions for input-output stability of nonlinear control systems are established. Input-output stability means that the system is simultaneously asymptotically stable in the large, strongly L_2-output stable and bounded-output stable. Continuous and discrete time systems with one and many nonlinear elements are considered. The stability theorems derived are Popov-type frequency domain conditions on the linear parts of the system. The main emphasis is on bounded-output stability; that is, a bounded input, not approaching zero as $t \to \infty$, yields a bounded output, but additional conditions may have to be imposed on the input. For instance, the first derivative of the input may be required to be bounded, as is the case of in the application of the V. M. Popov frequency inequality. Dissert. Abstr.

N68-30403# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
[JOINT SERVICES ELECTRONICS PROGRAM] Semiannual Progress Report, 1 Jul. – 31 Dec. 1967
Apr. 1968 86 p refs
(Contracts N00014-67-A-0298-0005; N00014-67-A-0298-0006; N00014-67-A-0298-0008)
(SAPR-75; AD-669693)

Materials are presented in fields relating to electromagnetic waves, electronics, and automation. TAB

N68-30450# Sperry Rand Corp., Philadelphia, Pa. Information Services Div.
UNIVERSAL FUNCTIONS
James T. Ellison Apr. 1968 90 p refs
(Contract F19628-67-C-0386)
(SR-1; AFCRL-68-0144; AD-669849)

The report deals with the theory and application of universal functions, with some attention to current and future logic design and technology. A universal function module is a logical network which is capable of performing every Boolean function of a fixed set of inputs by biasing its remaining inputs appropriately with zeros and ones; a universal function is the function the network, as a whole, performs. After an introductory section, there is a study of a universal function based on the EXCLUSIVE OR decomposition as an alternative to the universal function based on the minterm decomposition; a two-element EXCLUSIVE OR gate is suggested. Section III lists and discusses the 24 universal functions for one variable. The general theory of universal functions is developed in Section IV; their number, interrelationship, and relationship to other Boolean functions is determined. Section V considers certain kinds of universal function and multifunction modules. The report concludes with indications of areas for future research. Author (TAB)

N68-30460# Eidgenossische Technische Hochschule, Zurich (Switzerland).

A CONTRIBUTION TO THE THEORY OF TRANSITION TIME NETWORKS WITH PARTICULAR CONSIDERATION OF NEGATIVE FEEDBACK SYSTEMS [EIN BEITRAG ZUR THEORIE DER LAUFZEITNETZWERKE UNTER BESONDERER BERUECKSICHTIGUNG GEGENGEKOPPELTER SYSTEME]

Albert Schenkel (Ph.D. Thesis) 1967 104 p refs In GERMAN *Its* Dissertation No. 3976

CFSTI: HC$3.00/MF$0.65

The principles of the echo equalizer are used to analyze theoretically delay time cascades with emphasis on multiple degenerative circuits. Discussed are those calculation methods for impulse equalizers and impulse amplitude modulation that give the impulse discharge and the spectral transmission function. The stability problem for each case is expressed by three unbalanced equations and can be calculated up to four step cascades by graphic methods. A simplified method is used for the synthesis of filters with minimal and nonminimal phases of degenerative circuits that utilized reciprocal properties of the corresponding circuits with and without feedback. Numerical analyses of these theories are performed by digital computer programs. Transl. by G.G.

N68-30480# Eidgenossische Technische Hochschule, Zurich (Switzerland).

ELECTRONIC FILTER NETWORKS WITH DIGITAL SHIFT REGISTER [FILTERNETZWERKE MIT DIGITALEN SCHIEBEREGISTERN]

Peter Leuthold (Ph.D. Thesis) 1967 124 p refs In GERMAN *Its* Dissertation No. 3934

CFSTI: HC$3.00/MF$0.65

The theory of a new kind of electrical filters is treated which are composed of active elements and resistors only. These filters, called AC filters (analog-code filters), constitute further development of the so-called transmission line filters. The conventional transmission line can be replaced by a digital shift register, if the analog input signal is previously submitted to an analog-digital conversion. This may be simply achieved by means of pulse-code modulation or delta modulation. Following a detailed description of bloc diagrams and transfer behaviour of realizable AC filters a useful approximation method for the determination of finite Fourier sums is outlined. Some tables for the calculation of low-pass filters and an interesting example to get a simple single side-band modulator for data transmission are given. Author

N68-30513# Columbia Univ., Dobbs Ferry, N. Y. Hudson Labs.

ON THE ANALYSIS AND SYNTHESIS OF MULTI-LAYER RC DISTRIBUTED NETWORKS

Fung-yuel Chang (Ph.D. Thesis) Feb. 1968 179 p refs (Contracts Nonr-266(84); Nonr-266(66)) (CU-172-68-ONR-266-Phys.; TR-145; AD-670008)

This thesis is concerned with the study of multi-layer resistance-capacitance (RC) distributed networks. Such networks are formed by layers of dielectric material sandwiched alternately between layers of resistive material. The networks bear a resemblance to coupled RC transmission lines and can be regarded as multi-port networks. In this thesis we attempt to develop a complete theory of the multi-layer RC distributed network. The network will be described in terms of the explicit forms of the generalized ABCD (chain) matrices. Canonical expressions of the immittance and voltage transfer functions of the networks having uniform and piecewise uniform as well as certain nonuniform structures are derived. It is found that as far as the driving point immittance function is concerned, uniform RC (transmission) lines connected in series, in parallel, in cascade or the combinations can be replaced by a single multi-layer RC distributed network. The network also exhibits both the low-pass and band-pass characteristics with voltage gain greater than unity over a certain range of frequencies. Necessary and sufficient conditions are given under which a transcendental function can be realized as the network function of a multi-layer RC distributed network. Experimental results are also given to verify the theories developed in this thesis. Author (TAB)

N68-30550# Eidgenossische Technische Hochschule, Zurich (Switzerland).

INVESTIGATION OF AN ASYMPTOTIC BEHAVIOR OF A NON-LINEAR REGULATOR SYSTEM OF THE THIRD DEGREE [UNTERSUCHUNG DES ASYMPTOTISCHEN VERHALTENS EINES NICHTLINEAREN REGELSYSTEMS DRITTER ORDNUNG]

Eberhard Anselmino (Ph.D. Thesis) 1967 199 p refs In GERMAN *Its* Dissertation No. 4031

CFSTI: HC$3.00/MF$0.65

This work treats the asymptotic behavior of a feedback system with a linear transfer element of third order and a nonlinear element with $\sigma(x) = K(b^2x^3 - a^2x)$, where a^2 and b^2 have constant values. The negative (part I) or positive (part II) gain K is considered as a variable parameter. The input signal $u(t) = U \cdot \epsilon(t)$ is a step function with amplitude U, which represents the second variable parameter. For certain values of K and U exist self-excited oscillations with stable limit cycles in the three-dimensional phase space. A new kind of self-excited oscillations with limit cycles with several revolutions, i.e. of higher modi was found. The regions of stable oscillations and asymptotic stability could be represented in the parameter plane U-K. Analytic calculations of oscillations were done with the help of the describing function technique. Author

N68-30551# Rand Corp., Santa Monica, Calif.

SOVIET CYBERNETICS: RECENT NEWS ITEMS, NUMBER 17

Dorothy McDonald, ed. May 1968 56 p refs (P-3600/17; AD-670148)

The document contains reports on various aspects of Soviet cybernetics and computer technology, plus a review of recent literature dealing with these fields. TAB

N68-30562# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CYBERNETIC SYSTEMS WITH COMBINED CONTROL

A. G. Ivakhnenko 26 Sep. 1967 614 p refs Transl. into ENGLISH of the book "Kiberneticheskiye Sistemy s Kombinirovannym Upravleniyem" Moscow, Izd. Tekhn. p 1-512 (FTD-HT-23-578-67; AD-669931)

The book defines cybernetics as the science of the identification, organization, and most effective control of complex dynamic systems. The basic idea presented is that a new theory of large cybernetic systems must be developed on the basis of the theory of combined automatic control systems, which combine open-loop disturbance coupling and feedback with respect to internal and output variables, the feedback always containing elements of self-organization. Consequently, the theory of combined control systems may be the basis for the development of the general theory of combined deterministic-self-organizing cybernetic systems. First and second chapters present the theory of combined systems of the conventional type. The remaining chapters are devoted to combined cybernetic systems, in which the deterministic part is supplemented by a self-learning corrector. Three types of correctors are considered in separate chapters. First such type of corrector is the nonsearching regression extremal regulator. Second type of corrector is the setpoint accumulating matrix. Third type of corrector is entitled: control of spontaneous processes, recognition system. This last mentioned process is considered the most important problem for the future of cybernetics. The authors approach is: cybernetics begins where the possibility of mathematical description ends. TAB

N68-30608# Eidgenossische Technische Hochschule, Zurich (Switzerland).
THEORETICAL CONSIDERATIONS OF COUPLING TUBULAR CONDUCTOR WAVES THROUGH THIN IMPEDANCE LAYERS [THEORETISCHE BETRACHTUNGEN ZUR KOPPLUNG VON HOHLLEITERWELLEN DURCH DUENNE WIDERSTANDSSCHICHTEN]
Baldur Eliasson (Ph.D. Thesis) 1966 182 p refs In GERMAN *Its* Dissertation No. 3903
CFSTI: HC$3.00/MF$0.65

This paper deals with the coupling of guided waves through thin resistive films. The main part is devoted to the mathematical study of a directional coupler which utilizes the broadband coupling through a resistive film. An exact solution of the field problem in this kind of couplers is found. The problem is solved in two steps. First the film is assumed to be of semi-infinite length. The solution thus obtained is then modified to apply to the boundary conditions in a coupler of finite length. The solution is characterized by a square matrix of infinite order. The elements of the matrix represent the amplitudes of all excited modes. Both the first order theory, taking the film to be of semi-infinite length, as well as a second order approximation considering the finite length of the film, have been evaluated numerically. The theoretical values are found to be in very good accordance with the measured values. The second part of the paper is devoted to the technical aspects of resistive coupling. It is shown, how the results of the first part can be used as a basis for the design of resistive directional couplers. Author

N68-30664# Army Electronics Labs., Fort Monmouth, N. J.
COMPUTER STUDY OF SUBSIDIARY RESONANCE PHENOMENA IN MICROWAVE MAGNETIC MATERIALS
Samuel Dixon, Jr., Joseph W. McGowan, and Charles M. DeSantis May 1968 19 p refs *Its* Rept. Control Symbol OSD-1366
(ECOM-2963; AD-670013)

A computer study at X-band frequencies of the threshold fields for subsidiary resonance phenomena in a wide range of magnetic materials has been conducted. The variation of the critical power for spin-wave excitation has been determined as a function of the material parameters combined with the geometry of the ferrite material. The investigation has shown that, at a given frequency, low-level operation of microwave devices that utilize subsidiary resonance absorption requires a material with a very narrow spin-wave linewidth and a saturation magnetization in the order of 5000 gauss. The optimum material geometry that yields the lowest threshold is the case where the demagnetizing factor N sub z = 0, where z represents the direction of the applied dc field, and the transverse demagnetizing factors N sub x and N sub y are equal to 0.5. Author (TAB)

N68-30694# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
THE INVERSION OF THE CONVOLUTION PRODUCT IN PHYSICS (SURVEY TO THIS DAY) [L'INVERSION DU PRODUIT DE CONVOLUTION EN PHYSIQUE (MISE AN POINT BIBLIOGRAPHIQUE)]
Andre Girard 1967 13 p refs In GERMAN; ENGLISH summary *Its* Note Tech. No. 121
CFSTI: HC$3.00/MF$0.65

A survey was conducted to determine to what extent it is possible to know an input signal when the output function and the impulse response of the linear filter are known. The inevitable noise of the output signal practically suppresses the bi-univocal character of the convolution relation linking these three factors. However various numerical methods can be used to improve our knowledge on the input function in the frequency domain supporting the linear system. Theoretically it is possible to extend such knowledge beyond this domain. Author

N68-30857# Technion Research and Development Foundation, Ltd., Haifa (Israel).
NON-BINARY SWITCHING THEORY Final Scientific Report, 1 Nov. 1966–31 Jan. 1968
Michael Yoeli 10 Feb. 1968 11 p refs
(Grant AF-EOAR-21-67)
(AFOSR-68-0817; AD-669847)

The research was concerned with non-binary switching theory and its possible technical applications. The report summarizes the three main areas of research, namely: (1) multi-valued cellular cascades; (2) multi-valued feedback shift registers, and (3) design of an arithmetic unit using the symmetric ternary number representation. A list of publications prepared under the grant is given. TAB

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N68-29858# California Univ., San Diego. Inst. for Pure and Applied Physical Sciences.
DEVELOPMENT OF A SUPERSONIC NOZZLE MOLECULAR BEAM FACILITY
David R. Miller Apr. 1968 33 p refs
(Contract DA-31-124-ARO(D)-257; Proj. Defender)
(IPAPS-67/68-212; AROD-5133:169-P; AD-669490)

A supersonic nozzle molecular beam facility was developed and operated. Design, fabrication and operation of the major components of the vacuum system are described. Several of the important experimental components to be used in beam experiments are also described. Selected performance results are presented which indicate that the system is operating correctly and that beam characteristics are the same as those obtained in other laboratories. Author (TAB)

N68-29957*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ANALYSIS AND MECHANIZATION OF THREE AND FOUR GIMBAL SYSTEMS
John W. Wilson Washington Aug. 1968 33 p refs
(NASA-TN-D-4689) CFSTI: HC$3.00/MF$0.65 CSCL 14B

An approximate algebraic technique which extends the usefulness of three-gimbal systems is presented. In analyzing the three gimbal problem, the Euler angles are explored about the singular points and are found to be, in general, non-unique. This non-uniqueness is eliminated by minimizing the magnitude of the discontinuities at the singular points. An approximate mathematical model of the inverse Euler angle problem is developed which chooses the solution with minimum discontinuity and, in addition, replaces high rates over large angles by small discontinuities. A computer circuit is devised for this model. A proposed four gimbal system is investigated and a mathematical model is derived by finding a necessary differential constraint on the fourth angle to maintain a nonsingular formulation. This constraint is then used to derive a particular mathematical formulation in an essentially algebraic form, from which a computer circuit is developed. The rate equations of the four angles are also derived. Existing four gimbal stable platforms are analyzed and discussed. Author

N68-30005# Aeronautical Research Council (Gt. Brit.).
THE EQUILIBRIUM PISTON TECHNIQUE IN GUN TUNNELS
L. Davies, J. Regan, and K. A. Dolman Jul. 1967 31 p refs Supersedes NPL-AERO-1240; ARC-29308
(ARC-CP-982; PD-3603; NPL-AERO-1240; ARC-29308; AD-833465; AD-829789)

The technique whereby the piston is rapidly brought to rest at the end of the gun tunnel barrel, and the pressure peak which results is equal in magnitude to the final equilibrium pressure, is called the equilibrium piston technique. This technique was first demonstrated by East and Pennelegion. Details of the various formulae available for calculating the peak pressures are given, and from Stalker's formula an equation is derived which relates the equilibrium piston mass to the dimensions and initial conditions within the gun tunnel. Experiments performed in the NPL 2 in. gun tunnel using 20 and 25 gm pistons are described and shown to agree with theory. In all cases nitrogen was used as driver and test gas. Author (TAB)

N68-30018 West Virginia Univ., Morgantown.
CHARACTERISTICS OF A FINITE LENGTH M.H.D. TRAVELING WAVE CYLINDRICAL ACCELERATOR OR GENERATOR
Jerry Larkin Jester (Ph.D. Thesis) 1967 168 p
Available from Univ. Microfilms: HC $7.60/MF $3.00 Order No. 67-11788

The primary aim of this paper is to determine the characteristics of an electrodeless cylindrical traveling wave accelerator of finite length. Previous work in M.H.D. power generation has shown, particularly for A.C. electrodeless generators, that a major portion of losses are due to fringing effects related to the small number of wavelengths of the device. From practical considerations, it is desirable to maintain a reasonably short length for the accelerator or generator; on the other hand, the efficiency of these devices is particularly sensitive to fringing effects associated with short lengths. This theoretical study determines quantitatively the electrical efficiency of an accelerator or generator of length comprising any integral or fractional number of wavelengths of the primary coil windings. In the second part of the paper a solution is presented which determines the correction coils necessary to eliminate first order fringing losses. Numerical results are shown in terms of four basic non-dimensional parameters; namely the slip factor, magnetic Reynolds number, radius of the tube, and, finally, the length of the device. Dissert. Abstr.

N68-30019# National Physical Lab., Teddington (England). Aerodynamics Div.
DETERMINATION OF THE OPTIMUM RESERVOIR SIZE FOR THE DRIVER-RESERVOIR TECHNIQUE IN SHOCK TUNNELS
L. Davies, D. R. Brown (Univ. Coll. of Wales), and G. Hooper (Univ. Coll. of Wales) 26 Jan. 1968 29 p refs
(NPL-AERO-1255; ARC-29857; AD-834139)

The driver-reservoir technique is used when an increase in running time is required in shock or gun-tunnels. The increase is achieved by effectively eliminating the head of the expansion wave produced when the main diaphragm bursts. This paper describes the method of accurately determining the optimum reservoir size to ensure the efficient use of the technique. Author (TAB)

N68-30072# Aeronautical Research Council (Gt. Brit.).
THE THEORY OF INTERFERENCE EFFECTS ON DYNAMIC MEASUREMENTS IN SLOTTED-WALL TUNNELS AT SUBSONIC SPEEDS AND COMPARISONS WITH EXPERIMENT
H. C. Garner, A. W. Moore, and K. C. Wight Sep. 1966 61 p refs Supersedes NPL-AERO-1211 and ARC-28339.
(ARC-R&M-3500; NPL-AERO-1211; ARC-28339; AD-833469)

Experiment has already shown that the aerodynamic damping on half-span models in pitching oscillation is subject to interference effects that may exceed 30 per cent in slotted-wall tunnels at subsonic speeds. An explanatory theory is presented with numerous illustrations and comparisons with measured data. The basic assumptions demand a small ratio of model span to tunnel breadth, small frequency parameter and open instead of slotted boundaries nevertheless, the effects of span, frequency and slot geometry are considered theoretically, as well as those of tunnel shape, planform, model size, Mach number and pitching axis. Conclusions are drawn from studies in four different tunnels with their slots sealed and open. For a particular tunnel large discrepancies in the latter case are attributed to viscous effects that cause a wall with too narrow slots to behave like a closed boundary wall interference then changes sign, is less severe, but can no longer be detected by sealing the slots. Although the theory clarifies the problem, the usefulness of slotted-wall tunnels for dynamic measurement is open to question when corrections are very large. With inviscid flow the following conclusions are drawn from the theory (1) that the lift-damping due to pitching is subject to even more serious interference than the direct pitching damping, (2) that it may be impracticable to obtain adequate reduction in the wall corrections simply by testing smaller models, (3) that complete or more slender models are less seriously affected than half-models of moderate aspect ratio, (4) that with horizontal models in rectangular tunnels the best remedy is to have slotted side-walls but closed roof and floor. TAB

N68-30172# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
A TUBE WIND TUNNEL FOR HIGH REYNOLDS NUMBER SUPERSONIC TESTING
Theodore J. Falk Wright-Patterson AFB, Ohio ARL Feb. 1968 47 p refs
(Contracts AF33(657)-8860; AF33(615)-5389; FA-WA-4297)
(CAL-AD-2297-A-1; ARL-68-0031; AD-669353)

A modified Ludwieg tube wind tunnel which offers the possibility of high (i.e., full-scale) Reynolds number supersonic testing for the supersonic transport at relatively low cost is described. The modifications, consisting of a revised diaphragm location and a large downstream vacuum tank, are intended to reduce the starting time and starting loads found to exist in the basic Ludwieg tunnel. The operating characteristics of a short flow duration tunnel of this type are discussed along with the problems of instrumentation for a minimum design flow duration equal to one-twentieth of a second. It is anticipated that pressure, heat transfer, and skin friction data can be obtained with instrumentation similar to that now in use. Force data of the precision required for SST tests, however, are expected to be more difficult to obtain. Author (TAB)

N68-30205*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
GEOS 1 OBSERVATIONS AT MALVERN, ENGLAND
J. Hewitt, J. Rolff, and D. A. Arnold 30 Apr. 1968 50 p refs
(Contract NSR-09-015-018; Grant NsG-87-60)
(NASA-CR-95869; SAO Special Rept.-272; Rept.-803-95) CFSTI: HC $3.00/MF $0.65 CSCL 22D

The Smithsonian Astrophysical Observatory is collaborating with other agencies active in optical satellite tracking. Results from Geos 1 flash observations obtained by these agencies have been implemented in current SAO research programs on satellite geodesy. Proper implementation of these observations requires a detailed description of observation techniques and data processing applied by these agencies. This report deals with the methods used by the Royal Radar Establishment, Great Malvern, England. Accuracy estimates and some geodetic results are also presented. Author

N68-30317*# National Aeronautics and Space Administration, Washington, D. C.
VENTURE INTO SPACE: EARLY YEARS OF GODDARD SPACE FLIGHT CENTER
Alfred Rosenthal 1968 369 p refs
(NASA-SP-4301) GPO: HC$2.50; CFSTI: MF$0.65 CSCL 14B

The historical origins and traditions of this NASA Center, named in honor of Dr. Robert H. Goddard, one of the pioneers in the theory of space exploration, are described in terms of early rocket research and the growing interest in rocket technology after World War 2. The contributions of Project Vanguard to the United States space effort are reviewed, and it is pointed out that the personnel from Vanguard and other NACA laboratories formed the nucleus of the scientific team at the Center, which was dedicated on March 16, 1961. Organizational growth is traced, and project assignments are defined. The development of the tracking, data acquisition, and data reduction facilities is discussed, and details are given on the Goddard-managed satellites and space probes, the boosters that placed these satellites into orbit, and the sounding rocket flights. Organization charts and reports of procurement actions are included. The history covers the period through 1963, which is considered to be the end of Act One of the Space Age. M.G.J.

N68-30335 Laboratorio de Acustica e Sonica, Sao Paulo (Brazil).
REPORT OF ACTIVITIES FOR THE YEARS 1962/1967 [RELATORIO DE ATIVIDADES 1962–1967]
Dec. 1967 27 p refs In SPANISH; ENGLISH summary

Acoustic and ultrasonic technology in Brazil are reviewed, particularly in terms of activities at the Laboratorio de Acustica e Sônica for the period between 1962 and 1967. Problems in mechanical vibration measurements, ultrasonic inspection, industrial noise, and quality control are considered; and mention is made of plastic welding with ultrasonic energy and the use of ultrasonic interferometry. Other aspects covered in this review deal with staff development, published works of staff, and sponsorship and funds of the laboratory. M.W.R.

N68-30366# California Univ., Berkeley. Lawrence Radiation Lab.
A PROPOSED SAWTOOTH BUNCHER FOR THE 88-INCH CYCLOTRON AXIAL INJECTION SYSTEM
F. Resmini and D. J. Clark Mar. 1968 23 p refs
(Contract W-7405-ENG-48)
(UCRL-18125) CFSTI: HC$3.00/MF$0.65

A sawtooth wave buncher to be used in the axial injection system at the 88-inch cyclotron is described. Buncher mathematics, matching the cyclotron requirements, typical buncher parameters, and a survey of effects limiting the buncher operation are discussed. NSA

N68-30378# United Kingdom Atomic Energy Authority, Culham (England). Culham Translations Office.
FURTHER DEVELOPMENT OF THE CASCADE HIGH POWER ARC CHAMBER
H. Maecker and S. Steinberger Feb. 1968 12 p refs Transl. into ENGLISH from Z. Angew. Phys. (W. Berlin), no. 6, 1967 p 456–458
(CTO-477; NP-TR-1647) CFSTI: HC$3.00/MF$0.65

The cascade arc chamber for high-power cylindrical arcs consists of alternatingly stacked copper disks and insulating spacers, their central bore forming the tubular arc chamber. Each component of the chamber is briefly described. NSA

N68-30395# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
BALANCES AND DYNAMOMETERS USED AT THE O.N.E.R.A. MODANE TEST CENTER [BALANCES ET DYNAMOMETRES UTILISES AU CENTRE D'ESSAIS DE MONDANE-AVRIEUX]
Pierre Broussaud 1968 36 p refs In FRENCH; ENGLISH summary *Its* Note Tech. No. 122
CFSTI: HC$3.00/MF$0.65

An assessment is made of the problems found in the realization of systems adapted to the analysis and measurement of loads, with particular attention centered on the design and calibration of the aerodynamic balances equipping the transonic and supersonic wind tunnels. Also described is a technique of removable dynamometer balances used for stage separation tests in the vacuum tank and for propulsion tests. Author

N68-30459# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Porz (West Germany).
TESTS ON SUPERSONIC CASCADE TUNNEL SET UP OF THE NACA-6-INCH SUPERSONIC CASCADE TUNNEL AT THE DVL. DEVELOPMENT OF INSTRUMENTATION AND PRELIMINARY TESTS [UNTERSUCHUNGEN AM UBERSHALL-GITTERWINDKANAL AUFBAU DER NACA-6-INCH-UBERSCHALL-MESSSTRECKE IN DER DVL, ENTWICKLUNG DES MESSSYTEMS UND ERSTE VERSUCHSERGEBNISSE]
W. Heilmann and H. Weyer Feb. 1968 56 p refs In GERMAN; ENGLISH summary
(DLR-FB-68-28; DVL-752) CFSTI: HC$3.00/MF$0.65

For studying the characteristics of the supersonic flow in twodimensional cascades a wind tunnel has been installed at the DVL. It is now in operation. In this report, the various parts of the test facility, the air supply system, and the instrumentation are described. The work done in order to reach periodic flow conditions upstream and downstream of the cascade is furthermore described. Finally, measuring results are submitted and discussed. They belong to an investigation on the aerodynamic behaviour of bluntrailing-edge profiles in the upstream Mach number range from 1.45 to 1.65. Author

N68-30598*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
WATER CONDENSATION EFFECTS OF HEATED VITIATED AIR ON FLOW IN A LARGE SUPERSONIC WIND TUNNEL
Robert W. Cubbison and Edward T. Meleason Aug. 1968 12 p
(NASA-TM-X-1636) CFSTI: HC$3.00/MF$0.65 CSCL 14B

Natural gas was burned directly in the air stream of the Lewis 10- by 10-foot supersonic wind tunnel to control stagnation temperature. The test section Mach number was varied from 2.0 to 3.5, and stagnation temperature was varied to a maximum of 1140°R (634 K). Condensation of water vapor in the nozzle caused a decrease in test section Mach number and total pressure which was repeatable and accurately calibrated. The uniformity of the flow in the test section was similar to that of the unheated air. Author

N68-30623# Universidad Nacional Autonoma de Mexico, Villa Obregon. Facultad de Ciencias.
THE DYNAMITRON ACCELERATOR AND SEVERAL ASPECTS OF ITS ASSOCIATED SYSTEM [EL ACELERADOR DINAMITRON Y ALGUNOS ASPECTOS DE SU SISTEMA ASOCIADO]
Servando de la Cruz Reyna 1967 69 p refs In SPANISH
(NP-17359)

The characteristics of the Dynamitron accelerator and its associated optical system are summarized. The oscillator, high voltage system, ion source, and accelerator tube of the Dynamitron are described. The vacuum system and ion optics are discussed. The characteristics of the associated spectrograph are also given.
NSA

N68-30714# General Electric Co., Sunnyvale, Calif. Advanced Products Operation.
ELECTRON PROBE MICROANALYSIS OF RADIOACTIVE MATERIALS. 1: PRELIMINARY EXPERIMENTS AND PLANS FOR A SHIELDED FACILITY
H. S. Rosenbaum, T. A. Lauritzen, W. V. Cummings, and R. T. Peterson 30 Jun. 1967 60 p refs
(Contract AT(04-3)-189)
(GEAP-5344) CFSTI: HC $3.00/MF $0.65

Analytical studies of the behavior of fuels for fast breeder reactors benefit from electron probe microanalysis in determining the distribution of elements in the fuel, in the cladding, and in the regions where the fuel and cladding interact. Experiments in which a standard commercial electron probe microanalyzer was used on fuel and stainless steel cladding specimens whose total γ activity $\leq$50 mR/h at 1 foot are described; the data are relevant to the design of a shielded facility for the analysis of specimens of much higher γ activity. A detailed description of a shielded facility, including techniques developed to prepare, to handle, and to analyze unirradiated alpha-toxic materials and highly irradiated materials, is presented. Analytical limitations due to radioactivity are described.
Author (NSA)

N68-30731* Techtran Corp., Glen Burnie, Md.
WEIGHTLESSNESS AND ARTIFICIAL GRAVITATION [NEVESOMOSTI I ISKUSSTVENNAYA GRAVITATSIYA]
Ya. M. Shapiro Washington NASA Jul. 1968 9 p ref Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Aviats. Tekh. (Kazan), v. 10, no. 4, 1967 p 155–160
(Contract NASw-1695)
(NASA-TT-F-11767) CFSTI: $3.00 CSCL 14B

This work involves theoretical evaluation of the possibility of achieving simulated weightlessness and simulated gravitation over long periods of time. Included is a mathematical definition of weightlessness. It is shown that the period of weightlessness achievable in an aircraft flying a parabolic curve is less than 2 minutes. The conditions of the creation of artificial gravitation in a satellite are defined and some of the problems associated with the dynamics of a solid body under the conditions of artificial gravitation are examined.
Author

N68-30776# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
LABORATORY ELECTRON GUN—50 KV: THE CONSTRUCTION OF THE GUN AND MEASUREMENTS OF PARAMETERS OF ELECTRON BEAM [LABORATORYJNE DZIALO ELEKTRONOWE—50 KV: KONSTRUKCJA DZIALA I POMIARY PARAMETROW WIAZKI ELEKTRONOWEJ]
Lech Jakubowski and Elzbeita Skladnik-Sadowska 1968 36 p refs In POLISH; ENGLISH summary Submitted for publication
(P-893/XVIII/PP) CFSTI: HC $3.00/MF $0.65

A detailed description of the construction of a laboratory electron gun which ensures a beam current about 15 mamp with the extraction voltage 50 kV and with a magnetic focusing is presented. The most advantageous parameters and operational characteristics of the gun are established. By means of static and dynamic methods the shape and convergence of the electron beam as well as current density distributions over the beam cross-section were investigated. Determined on the basis of those measurements the minimum cross-over was equal 0.1 mm at the beam current 100/μamp. For the greater currents /up to some mamps at the voltage 15 kV/ the average current density amounted to 25 mamp/mm^2 is the cross-over of diameter about 0.5 mm.
Author

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N68-29563# General Research Corp., Santa Barbara, Calif.
THE THIN LAYER APPROXIMATION IN HYPERSONIC VISCOUS FLOW THEORY
J. A. Laurmann Mar. 1968 66 p refs
(Contract AF 49(638)-1569)
(CR-1569-1; AFOSR-68-0742; AD-669571)

A suggested thin layer approximation to the Navier-Stokes equations, suitable for hypersonic viscous flow over slender bodies, is solved approximately in a variety of ways for the case of flow over a flat plate at zero incidence. Two methods of solution appear to be most effective: an inner-outer representation for values of the interaction parameter v less than about 1/4; and for larger v, a linearized form of the equations in which the viscous and thermal diffusion rates correspond to the temperature at the plate surface. The result of calculations of the density field made with these two approaches are in approximate agreement with experiment over the major portion of the leading edge flow region. Greatest differences occur at the surface and in the shock region where the neglected nonlinear terms are most important. Theoretical analyses have as yet revealed no disagreement between the predictions of the thin layer hypersonic approximations and experiment—although the former are incomplete and at best approximate.
Author (TAB)

N68-29572 Arizona State Univ., Tempe.
INWARD FLOW OF AN INCOMPRESSIBLE FLUID BETWEEN ROTATING PARALLEL DISKS
Lee Allan Matsch (Ph.D. Thesis) 1967 141 p
Available from Univ. Microfilms: HC $6.80/MF $3.00 Order No. 67-10868

For this investigation, the laminar flow field was investigated resulting from the admission at a constant rate of an incompressible fluid between two closely spaced parallel disks, both of which rotate about their common axis at a constant rate. The fluid was considered to enter the disk spacing at the outer periphery, and to exit at an interior radial station. This effort was motivated by interest in the Tesla turbine, which relies upon the viscous shear stresses developed on the disk surfaces by the transmitted fluid to exchange energy with the rotating disks. Two conditions for fluid inlet to the disk spacing were considered. The first was that whereby the incoming fluid is admitted uniformly around the entire outer periphery. The second was that whereby fluid enters locally at the outer periphery through discrete entry slots. In addition, the hypothetical problem resulting from the admission of an inviscid and incompressible fluid entering locally at the outer periphery between two parallel and concentric disks was solved. The governing equations used to describe the laminar flow between the disks were the Navier–Stokes momentum component equations, together with the equation of continuity.
Dissert. Abstr.

N68-29590# Boeing Co., Renton, Wash. Commercial Airplane Div.
ACOUSTIC SCALING BETWEEN MODEL COLD FLOW AND HOT FLOW JETS

E. Grande Aug. 1967 54 p refs
(D6-20801TN; AD-669219)

The report presents acoustic far field data on a simple conical jet. The temperature of the jet flow is varied from ambient to 2600F in a range of Mach numbers from 0.4 to 2.0. The data are evaluated with the purpose of obtaining parameters for acoustic scaling between hot and cold flow model jets. The analysis is divided into three main phases which consider the following aspects of scaling: (1) Scaling between hot and cold jet noise spectra, (2) Total acoustic power scaling between hot and cold flow jets, and (3) The directivity of noise emission of hot and cold jets.
Author (TAB)

N68-29613 Arizona State Univ., Tempe.
AN ANALYSIS OF THE LAMINAR FLOW OF A VISCOUS, INCOMPRESSIBLE FLUID THROUGH A FULL ADMISSION MULTIPLE-DISK TURBINE
Keith Edward Boyd (Ph.D. Thesis) 1967 146 p
Available from Univ. Microfilms: HC $7.00/MF $3.00 Order No. 67-10860

The primary objective of this dissertation was to investigate the inward laminar flow of a viscous, incompressible, Newtonian fluid through a passageway formed by two closely spaced disks that are fastened to a rotating shaft. The solution of this flow problem produces the parameters which describes the performance of a disk turbine which has a rotor composed of several such parallel flow passageways. The fluid was considered to enter the flow passage in an axially symmetrical manner which corresponds to a full admission turbine rotor. The governing equations were derived from the Navier–Stokes equations and a continuity equation which were reduced the full passage width. The solution for the resulting problem statement was found to be governed by three parameters: a flow rate parameter, a tangential velocity parameter and the Reynolds number of the flow. The major work of this investigation was the numerical solution of the complete problem statement for which all required initial and boundary conditions were given. Considerable effort was expended investigating a "direct" difference technique for solving the governing equations.
Dissert. Abstr.

N68-29617 IIT Research Inst., Chicago, Ill.
ANALYSIS OF FLOW CHARACTERISTICS IN CIRCULAR, SUBMERGED, IMPINGING JETS
Tong Soo Kim (Ph.D. Thesis) 1967 161 p
Available from Univ. Microfilms: HC $7.60/MF $3.00 Order No. 67-12504

In this study, an analytical investigation was conducted on the momentum, mass and heat transfer characteristics in the flow field produced by an axisymmetric jet impinging normally on an infinite plane placed at a short distance from the nozzle. Specifically, the solutions were obtained for the boundary layer equations in order to determine the velocity distribution, wall shear and the heat transfer characteristics of the laminar boundary layer that forms over the impingement plane. A solution was also obtained for the momentum equation for the mixing layer at the free boundary of the jet. The equation was based on Prandtl's hypothesis on eddy viscosity in free turbulence. For the solution of the potential impinging jet, which serves as the bases for the solutions of the flow equations for the wall boundary layer and the mixing zone of the present problem, the results of LeClerc's study was utilized. The position of the mixing zone relative to the profile of the potential impinging jet was determined from continuity consideration taking into account the entrainment of the ambient fluid and the displacement of flow from the potential jet due to the reduction of velocity near the jet boundary caused by the presence of the mixing zone.
Dissert. Abstr.

N68-29681# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Gas Ionizzati.
ON THE DYNAMICAL INSTABILITIES OF A CYLINDRICAL INCOMPRESSIBLE SHELL
J. P. Somon Feb. 1968 60 p refs Sponsored in part by EURATOM
(LGI-68-4) CFSTI: HC $3.00/MF $0.65

Magnetic fields of the order of several megagauss have been obtained experimentally by compressing an initial flux by means of a well-conducting cylindrical shell. Assuming a perfect cylindrical symmetry, a maximum magnetic field is reached for a minimum or "turn around" radius. In the case considered the geometrical effect is important; the linear thickness varies widely during the motion. The liner is supposed to behave as a perfect incompressible fluid. Only the flute instabilities are considered. As consequence the magnetic field diffusion enters only through the boundary condition of a given pressure and the problem becomes hydrodynamic. Finally the linear approximation is used. Some properties of the perturbed motion are recalled and the equations for the perturbations are established. After brief considerations on the stability, applications are made to the special cases of perturbation wavelengths, small or large, compared with the liner thickness and with the case of the compression of a magnetic field. The growth-rates of the instabilities are numerically recalled.
ESRO

N68-29688 Arizona Univ., Tucson.
THE ENERGY EXCHANGE PROCESS IN A DIRECT CURRENT ELECTRIC ARC WITH LAMINAR AXIAL FLOW
Paul Seidell Masser, II (Ph. D. Thesis) 1967 127 p
Available from Univ. Microfilms: HC $6.20/MF $3.00 Order No. 67-11362

An analysis has been developed for determining the flow parameters in a constricted DC electric arc. This configuration is also commonly referred to as the tube arc and may be described as an axisymmetric tube flow with a superimposed concentric electric discharge. The flow is steady and laminar, the pressure and electric potential are independent of radial position, and thermal radiation is neglected. The analysis does not require the assumption of local thermodynamic equilibrium, but the gas properties which have been used are dependent on the assumption. The results of a literature survey indicates that two features are unique in this particular application. The analysis and computer program has been checked by extensive calculations including an energy balance to four significant figures and comparison with the independent results of five other investigators.
Dissert. Abstr.

N68-29709 Maryland Univ., College Park.
AN INVESTIGATION OF VOID FRACTION DISTRIBUTIONS IN VERTICAL COCURRENT GAS-LIQUID FLOW
Harold Pollack (Ph.D. Thesis) 1967 151 p
Available from Univ. Microfilms: HC $7.20/MF $3.00 Order No. 67-11321

Void fraction distributions were determined for vertical cocurrent air-water and air-isopropyl alcohol systems in a closed loop system which permitted simultaneous counter-gravity and cogravity bubble flow. The parameters studied included: pipe diameter, 2–4 inches; average void fraction, 10–25 per cent; and superficial liquid velocity, 3–7 feet per second. A scalar and scintillation probe were used to measure gamma ray attenuation through the two-phase mixture. Chordal void fractions were obtained from the gamma counts by means of an expression developed from the Beer-Lambert Law. Chordal void fractions were converted to point void fractions by means of a polynomial method. In this method, it was assumed that the point void fraction could be expressed by a polynomial which was a function of radial position. A linear regression technique was employed to determine the polynomial form to be used in this study.
Dissert. Abstr.

N68-29726 IIT Research Inst., Chicago, Ill.
TURBULENCE IN THE MIXING REGION BETWEEN COAXIAL STREAMS
Thomas Stanley Zawacki (Ph.D. Thesis) 1967 143 p
Available from Univ. Microfilms: HC $6.80/MF $3.00 Order No. 67-12506

An experimental study is made of axially symmetric, turbulent, incompressible, co-flowing streams. Hot wire anemometry techniques are used to make measurements in three systems, the homogeneous system with a resultant density ratio of 1, and two heterogeneous systems, one with an inner to outer stream density ratio of 4 to 1, and another with an inner to outer stream density ratio of 7 to 1. The outer stream velocity was varied from 12 to 50 ft/sec, and the inner stream was changed to provide outer stream to inner stream velocity ratios of from 1 to 40. Data is presented for the relative axial turbulence intensity, the relative radial turbulence intensity, and the turbulent shear stress for various velocity ratios in the homogeneous system, in both the initial mixing region and the downstream or similar region. The maximum relative turbulence intensity found was 0.40. Dissert. Abstr.

N68-29773 Naval Ordnance Lab., White Oak, Md.
A CRITICAL REVIEW OF ANALYTICAL METHODS FOR ESTIMATING CONTROL FORCES PRODUCED BY SECONDARY INJECTION: THE TWO DIMENSIONAL PROBLEM
Michael J. Werle 4 Jan. 1968 98 p refs
(NOLTR-68-5; AD-669445)

The problem discussed is that of theoretically predicting the normal force induced in the boundary layer separation region immediately ahead of a secondary injection port. Attention was limited to the two-dimensional problem of sonic or supersonic normal injection into supersonic or hypersonic mainstreams. A critical review of available experimental studies was conducted in order to isolate those data best representing a two-dimensional state. The resulting compilation of experimental results was thereafter employed as a basis of comparison for available theoretical and empirical flow models. As a result it was found that analytical means are only capable of rough quantitative estimates of control jet effectiveness and that a more detailed flow model is needed to further explain observed phenomenon. The basic features of such a model are formulated and its conceptual validity demonstrated through comparison with experimental results. Problem areas requiring further research are also discussed in detail. Author (TAB)

N68-29783 Rice Univ., Houston, Tex.
A GENERAL FORMULATION OF THE BOUNDARY CONDITIONS ON THE VECTOR POTENTIAL IN THREE-DIMENSIONAL HYDRODYNAMICS
George Jiro Hirasaki (Ph.D. Thesis) 1967 54 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-13082

One of the most promising methods of solving the Navier-Stokes equations for incompressible flow in three dimensions involves a formulation using a vector potential. The vector potential in three dimensions plays a role similar to that of the stream function in two dimensions. Determination of the proper boundary conditions on the vector potential is much more difficult than the corresponding two-dimensional problem and is the subject of this paper. It is shown that the boundary conditions can always be found by solving a second order elliptic partial differential equation on the boundary. Several examples are given and one example is discussed in detail including development of the boundary condition and numerical solution of the equations of motion. Dissert. Abstr.

N68-29801 Ohio State Univ., Columbus.
THEORETICAL ANALYSIS OF INITIAL VELOCITY EFFECTS IN TURBULENT DISPERSION OF DISCRETE PARTICLES
Bihari Lal Vaishnavi (Ph.D. Thesis) 1967 64 p
Available from Univ. Microfilms: HC $3.60/MF $3.00 Order No. 67-10930

The motion of a large cluster of small, spherical-shaped, discrete particles (solid or liquid), having non-zero initial velocity, in a turbulent, fluid-flow field is investigated. Initially, a large number of identical, non-interacting particles are considered. It is shown that the effect of heterogeneous particle sizes can be considered if the size-distribution of particles is known. The statistics of particle motion, including the mean particle velocity and, in particular the turbulent diffusivity, are obtained as functions of, (1) the corresponding statistics of fluid-motion, (2) time, (3) external forces (assumed constant), and (4) the density and size of particles, and the density and viscosity of the ambient fluid. It is found that unlike the case of particles starting from rest, the particles have a mean motion which is not constant, but depends strongly on time. This velocity is seen to be a function of initial fluid velocity and buoyancy forces, but independent of the initial particle velocity, for asymptotically large times. Dissert. Abstr.

N68-29802 Oregon State Univ., Corvallis.
MASS TRANSFER AT THE SOLID-LIQUID INTERFACE FOR CLIMBING FILM FLOW IN AN ANNULAR DUCT
Anthony Michael Sutey (Ph.D. Thesis) 1967 183 p
Available from Univ. Microfilms: HC $8.40/MF $3.00 Order No. 67-11532

A method utilizing a diffusion controlled electrochemical reaction was used to measure average and instantaneous mass transfer coefficients at the solid-liquid film interface in upward gas-liquid climbing film flow in a vertical annular duct. Experimental average mass transfer coefficients are estimated to be accurate within ± 5%. These measurements give some indication of the mechanics of flow of the film, the extent of turbulence at the inner wall, and the effect of film thickness and wave motion on the mass transfer process at the inner wall. Predictions of incipient downflow of the film shear stress at the inner wall, and interfacial shear stress were obtained from these measurements. Fluctuations in the velocity gradient at the inner wall were also studied. Results of this study were compared with previous work and with theoretical predictions based on laminar film concepts. Dissert. Abstr.

N68-29803 Virginia Polytechnic Inst., Blacksburg.
ISOTHERMAL FLOW OF NEWTONIAN FLUIDS THROUGH CONICAL PACKED BEDS OF UNIFORM SPHERES
Sigmund Albert Schildcrout (Ph.D. Thesis) 1967 131 p
Available from Univ. Microfilms: HC $6.40/MF $3.00 Order No. 67-11374

The purpose of this investigation was to study the flow of Newtonian fluids through uniformly tapered packed beds having cone angles between 1.48 and 8.52 degrees. The beds were randomly packed with uniform spherical particles which ranged in size from 0.048 to 0.232 inch. Fluid velocities were regulated between 0.025 and 1.85 feet per second; the viscosities varied from 0.32 to 21.7 centipoises. The resulting range of Reynolds number was 0.82 to 15,000. An apparatus was constructed in which fluid could be pumped through the packed beds in either the converging or diverging direction. Pressure taps were located at convenient distances along the test section so that pressure-position relationships could be recorded. A model to describe flow in uniformly tapered packed beds based on hydraulic radius capillary theory modifications of the Sutterby equation was developed. Dissert. Abstr.

N68-29804 Tennessee Univ., Knoxville.
RHEOLOGICAL STUDY OF VISCOSITIES AND PIPELINE FLOW OF CONCENTRATED SLURRIES
Esber Ibrahim Shaheen (Ph.D. Thesis) 1967 187 p
Available from Univ. Microfilms: HC $7.80/MF $3.00 Order No. 67-10745

A study of viscosities and pipeline flow of concentrated slurries was conducted. Entrance effects along with the following variables were studied: volume fraction of solids, shear rate, particle size and particle size distribution. The equipment consisted of precision glass tubing of various diameters and a recirculation pumping system. The slurry was a suspension of styrene divinyl benzene beads in water. The shear rate was varied from 100 to 700 sec.$^{-1}$; the particle size, from 57 to 135.5 microns; and the volume fraction, from 0.20 to 0.55. The behavior of monodisperse slurries may be summarized as follows: the relative viscosity decreases with increasing shear rate for values of the volume fraction up to about 0.50, and increases with increasing particle size. For a mixture of two sizes of particles, the relative viscosity goes through a minimum as the ratio of small to large particles changes. Dissert. Abstr.

N68-29807# RAND Corp., Santa Monica, Calif.
ON TURBULENT SHEAR FLOWS OF VARIABLE DENSITY
John Laufer May 1968 42 p refs
(Contract DAHC15-67-C-0141; ARPA Order-189-1)
(RM-5549-ARPA; AD-669563)

A study was made of the mean flow field of free turbulent layers of variable density showing that if the velocity distribution in a particular constant-density flow is known, it is possible to obtain the corresponding variable-density velocity field without the introduction of a compressible turbulent viscosity. This is accomplished by a Dorodnitsyn-Howarth type of transformation applied to the time-dependent equations of motion rather than to the mean equations of motion, as has been done previously. When the transformed equations are averaged, using Reynolds method, the incompressible turbulent equations for the mean flow are obtained. These equations can then be handled by conventional methods. Predictions obtained by this procedure agree well with experimental results. Author (TAB)

N68-29815# Mithras, Inc., Cambridge, Mass.
STUDIES OF NITRIC OXIDE CHEMILUMINESCENCE USING BOUNDARY LAYER APPROXIMATIONS Final Report, Feb–Dec. 1967
R. Earl Good, Jacques A. F. Hill, and Leonard Silver Apr. 1968 80 p refs
(Contract F19628-67-C-0025)
(MC-66-268-R1; AFCRL-68-0143; AD-669582)

The interface layer generated when a sonic jet is directed against a supersonic stream was analyzed by means of the boundary-layer equations for stagnation point flow. The gas from the jet is assumed to react chemically with the free-stream gas in a second order reaction. The parameters defining a particular solution are the normalized jet gas blowing rate and a Damkohler number relating the reaction rate to the velocity gradient along the interface layer. Numerical solutions were obtained covering a range of values of both parameters. The results presented emphasize the variation in concentration profiles through the layer as the Damkohler number is changed. They show that as the Damkohler number increases the total reaction between the two streams changes from a rate-controlled to a diffusion-controlled regime. The results were applied to the chemiluminescent reaction NO + O yields NO2 + photon and compared with measurements obtained in a low-density supersonic wind tunnel. The measurements clearly illustrate the transition between the two regimes and yield the bimolecular rate constant k = 1.8 x 10 to the -12th power cc/mole sec. Author (TAB)

N68-29882# Aeronautical Research Council (Gt. Brit.)
BOUNDARY LAYER BLEED DRAG AT SUPERSONIC SPEEDS
E. L. Goldsmith London HMSO 1968 24 p refs Supersedes RAE-TR-66143; ARC-28320; see X66-24040
(ARC-R&M-3529; RAE-TR-66143; ARC-28320) CFSTI: HC $3.00/MF$0.65

Four types of flow in boundary layer bleeds are discussed. Expressions are given for calculating the bleed internal drag for the various types using two alternative definitions of drag. Some general curves are plotted which show the dependence of bleed drag on bleed pressure recovery and free stream Mach number. A number of calculated and measured bleed pressure recoveries are compared. Calculations have been made which show under what conditions there is no longer a performance advantage in "burying" engines within the adjacent body or wing. Other calculations compare the drag obtained by ejecting the bleed air slowly (base bleed) with no boat-tailing on the nacelle and ejecting the air as a high speed flow combined with the concomitant boat-tailing. Author (ESRO)

N68-29893# Aeronautical Research Council (Gt. Brit.).
THE LOCAL PRESSURE FIELD OF TURBULENT JETS
P. O. A. L. Davies (Southampton Univ.), N. W. M. Ko (Southampton Univ.), and B. Bose (Southampton Univ.) 1968 32 p refs Supersedes ARC-29065
(ARC-CP-989; ARC-29065; AD-833467)

The characteristics of the pressure field associated with the turbulent shear flows of a jet have been studied in some detail. Components of the field in the potential core appear to be moving with a phase velocity equal to the local speed of sound in directions roughly normal to the shear layer. Some components of the hot wire signal can be associated with the jet structure as a single complex source while others are related to the local characteristics of the turbulence. An estimate of the strength of the fluctuating pressure field throughout the whole region of the jet flow is presented. Author (TAB)

N68-29897# Aeronautical Research Council (Gt. Brit.).
THE EFFECT OF INITIAL CONDITIONS ON THE DEVELOPMENT OF TURBULENT BOUNDARY LAYERS
P. Bradshaw and D. H. Ferriss 1968 39 p refs Supersedes NPL-AERO-1223; ARC-28771
(ARC-CP-986; PD-3602; NPL-AERO-1223; ARC-28771; AD-833466; AD-860621)

Calculations by a method that is believed to be reasonably accurate have been made to demonstrate how perturbations decay, in zero pressure gradient, until all that remains is a change in boundary layer thickness. Initial perturbations in typical aerofoil pressure gradients can usually be represented by an equivalent change in initial boundary layer thickness, which produces percentage changes of the same order of magnitude in distance to separation. Author (TAB)

N68-29899 California Univ., Berkeley.
ON THE DYNAMICS OF A VAPOR BUBBLE
Soung Moo Cho (Ph.D. Thesis) 1967 182 p
Available from Univ. Microfilms: HC $8.40/MF $3.00 Order No. 67-11605

Some aspects of vapor bubble dynamics have been studied. Firstly, a case in which a vapor bubble initially at equilibrium state with its infinitely extended liquid begins to collapse due to a sudden pressurization in the liquid was considered. In general, the mode of collapse is governed by both the liquid inertia and the heat transfer from the vapor-liquid interface into the bulk liquid. Secondly, the growth and collapse of a vapor bubble in sub-cooled surface boiling was studied. It is learned that a model which neglects the effect of a thin liquid layer under a bubble in surface boiling cannot predict the right maximum bubble size mainly because the amount of energy contained in a superheated liquid layer at the time of nucleation is too small to produce the experimentally observed maximum radius. Lastly, some limiting cases in which either the momentum or energy equation is considered were studied. The Rayleigh bubble, whose pressure remains constant, collapses with an ever-increasing rate of collapse which finally becomes

infinite at completion for $p_\infty > p_{v,o}$ and grows indefinitely with the rate of growth which soon becomes linear with time for $p_{v,o} > p_\infty$ Dissert. Abstr.

N68-29901 Idaho Univ., Moscow.
MECHANISMS OF LIQUID FLOW IN PACKED BEDS
George Burton Irving (Ph.D. Thesis) 1966 235 p
Available from Univ. Microfilms: HC $10.60/MF $3.05 Order No. 67-5378

A study was made of the lateral and longitudinal dispersion of liquids in beds of spheres in order to elucidate the mechanism of liquid flow through packed beds. The distribution of liquids at a wall in a bed of spheres was also studied to determine the wall effect of a packed column. The effects of changes in liquid properties on lateral dispersion, longitudinal dispersion and the distribution at a wall were determined. The random-walk theory was used as a model for lateral dispersion of liquid for unconfined distribution. The random-walk theory, with total reflection or adsorption at a barrier, was evaluated as a model for liquid distribution at a wall. The results of the study show that neither total reflection nor adsorption of liquid occurs at a wall. At low flow rates all lateral flow is toward the wall. At higher flow rates an equilibrium is established between the liquid flowing on the wall and in the packing adjacent to the wall. Longitudinal dispersion of liquid in beds of spheres was shown to be described by a model of perfect mixers in series. At high flow rates of water the number of perfect mixers is the actual number of pools while for lower flow rates liquids containing surface-active agents, or liquids of higher viscosity, the actual number of mixers must be replaced by an effective number of perfect mixers. The effective number of perfect mixers is smaller than the actual number of mixers because of a reduction in the "efficiency" of mixing in each pool. Dissert. Abstr.

N68-29919*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
BACK FLOW FROM JET PLUMES IN VACUUM
Norman T. Grier 1968 8 p refs Presented at 6th Intern. Symp. on Rarefied Gas Dyn., Cambridge, Mass., 22–26 Jul. 1968
(NASA-TM-X-52468; E-4168) CFSTI: HC $3.00/MF $0.65 CSCL 20D

Approximate analytical calculations are performed to determine the particle density at surrounding points forward of a jet nozzle in vacuum due to the gas exhausted in the jet plume. The calculations are made for helium, argon and nitrogen. The back flow is determined from the number of particles that leave the continuum regime and cross the particular point in question without experiencing any interparticle collisions. Author

N68-29967# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THEORY OF SHOCK WAVES AND INTRODUCTION TO GAS DYNAMICS
Ya. B. Zel'dovich 29 Aug. 1967 237 p refs Transl. into ENGLISH of the book "Teoriya Udarnykh Voln i Vvedeniye v Gazodinamiku" Moscow, Izd. AN SSSR, 1946 p 1–186
(FTD-HT-66-258; AD-669272)

Gas dynamics is defined as the science of motion at great pressure differentials and high velocities, velocity being measured in terms of the speed of sound. The book confines itself to specific phenomena of gas dynamics, i.e., those which have no analogies in the mechanics of an incompressible liquid. Emphasis is placed on careful definition of the fundamentals of gas dynamics, fundamental laws, and methods of solving simplest problems, rather than on the computational methods of gas dynamics or methods of numerical integration of complex two- and three-dimensional flows, etc. Attention is devoted to problems of flow around bodies moving at great speeds, motion of a gas in ducts such as nozzles and pipes, and compressibility of the moving medium. The second main topic is shock waves considered under the theory of shock waves, shock wave laws, and the problem of the destructive effect of explosions and propagation of the explosion on the explosive substance (capable of chemical reaction). The text is intended to also serve as an introduction to the theory of explosions. Author (TAB)

N68-29977 Pennsylvania State Univ., University Park.
AN EXPERIMENTAL INVESTIGATION OF THE VISCOUS SUBLAYER IN TURBULENT PIPE FLOW
Henry Palmer Bakewell, Jr. (Ph.D. Thesis) 1966 180 p
Available from Univ. Microfilms: HC $8.20/MF $3.00 Order No. 67-5892

The highly viscous fluid, glycerine, was used in a detailed experimental investigation of the viscous sublayer. Detailed measurements of the streamwise fluctuating velocities were obtained with hot-film anemometers within the viscous sublayer as well as in the transition region between the linear and logarithmic mean velocity profiles. These data were used to form the space-time correlation function of the streamwise velocities. The energy spectra and cross-spectra of the streamwise fluctuating velocities were obtained by Fourier transformation of the autocorrelation and cross correlation data, respectively. In addition, the correlation data were utilized to obtain an eigenfunction decomposition of the streamwise fluctuating velocity. This information coupled with a mixing length approximation and the continuity equation provided a description of the dominant large scale structure within the wall region. Dissert. Abstr.

N68-29998 Delaware Univ., Newark.
THE MOTION OF SPHERICAL-CAP BUBBLES IN SUPERHEATED LIQUIDS
Robert Alfred Yates (Ph.D. Thesis) 1966 142 p
Available from Univ. Microfilms: HC $6.80/MF $3.00 Order No. 67-11749

Potential flow theory is applied to derive a differential equation which reliably describes the unsteady velocity of rise of spherical cap bubbles which are simultaneously increasing in volume. The equation is integrated for a time dependent radius described by the equation $R = at^{1/m}$ and is expressed in such a way as to give velocity of rise as a function of the radius of curvature of the spherical portion of the bubble and the parameters a and m of the above equation. An experimental study consisting of photographing expanding bubbles with a high speed camera provided evidence to verify the reliability of the derivation. Measurements of bubble size, area, radius, position, fluid temperatures, pressure, and time make possible the calculation of heat transfer coefficients as a function of bubble radius, the temperature dependence of growth rate, and geometry changes of the bubble as a function of growth rate as well as velocity of rise as a function of radius. A brief discussion of the interference of one bubble with another is included as a minor facet of the study. Dissert. Abstr.

N68-30022# Brown Univ., Providence, R. I.
ENHANCEMENT OF HEAT AND MASS TRANSFER IN A STAGNATION REGION BY FREE STREAM VORTICITY
George Williams Wright-Patterson AFB, Ohio ARL Feb. 1968 118 p refs
(Contract F33615-67-C-1754; Grant NSF GK-575)
(ARL-68-0022; AD-669330)

Calculations were performed using a mathematical model to show the effect of free-stream turbulence on stagnation-point heat transfer from circular cylinders in cross-flow. The calculations were performed on an IBM 1130 digital computer for a wavelength equal to 5/3 times the neutral wavelength for the flow. This wavelength was obtained from experimental mass transfer results. The Prandtl numbers used in the computations were 0.70, 2.70, 2.85, 3.00, 7.00 and 100, and the amplitude parameter A had the range 0.0(0.5)3.0. The results of the calculations show that the

mean heat transfer at the stagnation point increases with Prandtl number for each value of the amplitude parameter used in the calculations, and that the largest increase occurred for a Prandtl number equal to 100. A method is proposed on how to relate the amplitude parameter A to free-stream turbulence intensity. For a Prandtl number of 2.85, a comparison is made between heat transfer results of the model and experimental mass transfer results. The agreement between results is found to be satisfactory. Author (TAB)

N68-30036 City Coll. of the City of New York.
THE EFFECT OF A SMALL NUMBER OF INERT PARTICLES ON THE LOCAL AND OVERALL MASS TRANSFER RATES FROM A SINGLE SPHERE AT LOW REYNOLDS NUMBERS
Alan Peltzman (Ph.D. Thesis) 1967 265 p
Available from Univ. Microfilms: HC $11.95/MF $3.45 Order No. 67-12565

An investigation was undertaken to study the phenomenon of particle-to-fluid mass transfer in multiparticle systems. Local and overall mass transfer rates from a single active sphere either alone or in the presence of one or more inert spheres were determined experimentally, at low Reynolds number (5–150), high Peclet number (3,500–150,000) flow. Data were obtained by measuring the diminution profile of a spherical particle of either benzoic acid or beta naphthol due to water flowing past the rigidly held particles in a cylindrical tube. Single sphere results show that flow separation does not appear to occur at a Reynolds number of 5 but is striking at a Reynolds number of 25. The location of the separation ring is dependent upon Reynolds number. Numerous results were obtained for spheres in axial, equilateral triangular and hexagonal configurations. They show the marked effect particle-to-particle interactions have on particle-to-fluid mass transfer and on the hydrodynamic flow pattern around particles. Dissert. Abstr.

N68-30079# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CALCULATIONS OF STANDARD INTEGRALS IN MOMENT KINETIC EQUATIONS [VYCHISLENIE STANDARTNYKH INTEGRALOV V MOMENTNYKH KINETICHESKIKH URAVNENIYAKH]
Ye. V. Alekseyeva, R. G. Barantsev, V. F. Butov, and L. L. Zvorykin 21 Jul. 1967 24 p refs Transl. into ENGLISH from Aerodinam. Razrezhennykh Gazov, Leningr. Gos. Univ., Nauchn.-Issled. Inst. Mat. i Mekhan. (Leningrad), no. 2, 1965 p 79–97
(FTD-MT-66-165; AD-670119)

The method of kinetic moment equations permits the evaluation of a significant number of quadratures using an analytic form which is identical for the entire class of problems covered by the integral kinetic operator of the aerodynamics of rarified gases. Such quadratures represent a contribution to the solution of all kinetic problems since they refer to that part of the development which can be covered using general procedures. The physical content and universal character of such quadratures makes the study of their internal structure worthwhile. The paper presents the evaluation of these integrals appearing during Hermite polynomial expansions of the collision and generating functions within a monatomic gas. Author (TAB)

N68-30087*# North American Aviation, Inc., Downey, Calif. Space and Information Systems Div.
A STUDY OF LONGITUDINAL OSCILLATIONS OF PROPELLANT TANKS AND WAVE PROPAGATIONS IN FEED LINES. PART 1: PROPAGATING PRESSURE WAVES IN A FLUID-FILLED CYLINDRICAL SHELL
John S. Kanno and Clement L. Tai 31 May 1967 76 p refs
(Contract NAS8-11490)
(NASA-CR-61884; SID-67-212-1) CFSTI: $3.00 CSCL 20D

The properties of the propagating pressure waves as established by a two-dimensional theory of the fluid are derived, assuming an axially symmetric, inviscid, and compressible liquid. The cylinder bounding the fluid is treated in accordance with shell theory. The bending rigidity of the shell wall is included, but the transverse shearing rigidity is not. The equations of motion of the fluid and shell perturbations with respect to a steady-state flow are reviewed. For propagating harmonic hydroelastic waves, the nature of the fluid pressures depends on whether or not the phase velocity of the wave exceeds the acoustic velocity. A simplified solution of the equations of motion is resolved for steady-state flows with velocities less than the phase velocities of the propagating waves. The calculated values for propellant feed lines of rockets are presented. The behavior and the occurrence of the water hammer, the effect of the fluid on shell wall vibrations, and the acoustic behavior of the fluid are reviewed. Author

N68-30108 Iowa State Univ. of Science and Technology, Ames.
PRESSURE DISTRIBUTION ON A FIXED SURFACE PARALLEL TO A ROTATING DISK
Leo Charles Peters (Ph.D. Thesis) 1967 101 p
Available from Univ. Microfilms: HC $5.20/MF $3.00 Order No. 67-12986

This study presents an investigation of the steady, incompressible, constant viscosity flow of a Newtonian fluid in a narrow gap between a rotating disk and a stationary parallel plate. Particular emphasis was placed on the determination of the static pressure distribution on the stationary plate. Experimental work was conducted to determine pressure distributions on the stationary plate using air as a fluid. In the analysis of the results the Navier-Stokes equations were assumed to be the governing equations and the significance of the various terms in the equations were determined from an order of magnitude analysis. Experimentally determined pressure distributions were used to substantiate the significance of the dimensionless parameters. This was done by comparing the experimental pressure distributions to pressure distributions calculated from an approximate solution of the Navier-Stokes equations. The agreement was not good because the analysis of the Navier-Stokes equations showed that the convective terms could not be neglected in the range of parameter values used in the experimental work. Dissert. Abstr.

N68-30110# Naval Ship Research and Development Center, Washington, D. C. Hydromechanics Lab.
TURBULENT BOUNDARY LAYER CHARACTERISTICS OVER A ROUGH SURFACE IN AN ADVERSE PRESSURE GRADIENT
Victor E. Scottron (Ph.D. Thesis) Sep. 1967 170 p refs
(NSRDC-2659; AD-669486)

The boundary layers produced on rough surfaces in adverse pressure gradients were investigated. Experimental data on two pressure gradients are studied and compared with flow over a smooth surface. Experimental data obtained with both pitot tubes and hot wires are carefully analyzed and corrected for the effects of high level turbulence. An improved pitot tube correction is proposed. It is shown that a boundary layer on a rough wall will separate more readily than on a smooth wall. Author (TAB)

N68-30145# European Space Technology Center, Noordwijk (Netherlands).
AUTOMATIC SOLAR-CELL TEST FACILITY AT ESTEC
A. W. Preukschat Paris ESRO Dec. 1967 46 p
(ESRO-TN-8) CFSTI: HC $3.00/MF $0.65

Details are given on the test equipment for automatic measurements of the operational characteristics of 20 solar cells measuring 1 × 2 cm^2 or 2 × 2 cm^2. The method of program selection is described, circuit diagrams of the measurement command system are presented, and the electrical operation is explained. Author (ESRO)

N68-30258*# University of Southern Calif., Los Angeles.
THE THREE-DIMENSIONAL STEADY RADIAL EXPANSION OF A NEWTONIAN GAS FROM A SONIC SOURCE INTO A VACUUM
William B. Bush [1968] 19 p refs
(Grant NGL-05-018-044)
(NASA-CR-95883) CFSTI: HC$3.00/MF$0.65 CSCL 20D

The three-dimensional steady radial expansion of a viscous, heat-conducting compressible fluid from a spherical sonic source into a vacuum is analysed using the Navier-Stokes equations as a basis. It is assumed that the model fluid is a perfect gas having constant specific heats, a constant Prandtl number of order unity, and viscosity coefficients varying as a power of the absolute temperature. Limiting forms for the flow variable solutions are studied for the case where the Reynolds number based on the sonic source conditions goes to inifinity and ratio of the constant specific heats goes to one. Through the use of asymptotic expansions and matching, it is shown that, for the above limit, in what is, to leading approximation, an isothermal process, the velocity goes to zero and the pressure goes to a finite vacuum value, as the radial distance approaches infinity. Three distinct regions span the distance between the sonic source and the vacuum, namely: (1) an inviscid source region, in which there is a convection-pressure gradient balance; (2) a (slightly) viscous downstream region, in which there is a convection-pressure gradient-hoop stress balance; and (3) a (fully) viscous far downstream region, in which there is a convection-shear stress-hoop stress balance. Author

N68-30282 Southampton Univ. (England). Inst. of Sound and Vibration Research.
THE LOCAL FIELDS OF TURBULENT JETS
P. O. A. L. Davies, B. Bose, and N. W. M. Ko [1967] 19 p refs Sponsored by UNESCO, Min. of Technol., and Sci. Res. Council *Its* I.S.V.R. Memo. No. 223

Pressure measurements are presented which describe the characteristics of the near field surrounding a model air jet. Measurements are also presented of the characteristics of the potential field which is associated with the turbulent shear layer. The potential field has been described in the potential core, within the turbulent mixing region, and in the region surrounding the jet by analysing two point hot wire measurements. The measurements in the three regions are compared to deduce the related characteristics. It is shown that some of the observed components of the hot wire signals appear to move with a phase velocity equal to the local speed of sound in a direction roughly normal to the shear layer, while others move with the turbulent flow. An estimate of the strength of the fluctuating pressure field throughout the whole region of the jet flow is presented, based on the hot wire measurements and measurements of the near field pressure with a microphone. Author

N68-30397*# Techtran Corp., Glen Burnie, Md.
ASYMPTOTIC BEHAVIOR OF MASS, MOMENTUM, AND ENERGY FLUXES ON A SEMI-INFINITE PLATE AT LARGE MACH NUMBERS [ASIMPTOTICHESKOYE POVEDENIYE POTOKOV MASSY, IMPUL'SA I ENERGII NA POLUBESKONECHNOY PLASTINKE PRI BOL'SHIKH M]
Yu. Shlazha Washington NASA Aug. 1968 30 p refs Transl. into ENGLISH from Vestn. Leningr. Univ., Ser. Mat., Mekh. i Astron. (Leningrad), v. 23, no. 1, 1968 p 120–138
(Contract NASw-1695)
(NASA-TT-F-11865) CFSTI: HC$3.00/MF$0.65 CSCL 20D

Kinetic study of the asymptotic properties of gas-particle impact frequencies (N), tangential pulses (p_x), and energy transfer (E) at the leading edge of a plate situated in a gas flow at large Mach numbers was made. Integral equations for the asymptotic distribution functions involved and expressions for N, p_x, and E are derived. The analytical results are found to be in good qualitative agreement with the results of Kogan and Degtyarev. Author

N68-30431# European Atomic Energy Community, Ispra (Italy). Engineering Dept.
MEASUREMENT OF THE VOID FRACTION IN A TWO PHASE NaK/ARGON FLOW BY GAMMA RAY ATTENUATION [MESURE DE LA FRACTION DE VIDE DANS UN ECOULEMENT DOUBLE PHASE NaK-ARGON PAR ATTENUATION D'UN RAYONNEMENT GAMMA]
B. Milliot, J. Lazarus, and J.-Ph. Navarre Brussels Jun. 1968 55 p refs In FRENCH; ENGLISH summary
(EUR-3935.F) CFSTI: HC$3.00/MF$0.65

For determining the void fraction in a two-phase flow artificially created by injecting argon in a flow of NaK, the γ-attenuation method was used. This measuring method has been applied simultaneously with other methods already described. The results obtained in 1966 are confirmed by the new set of tests. Reproductibility is satisfactory. The γ-attenuation method gives good experimental results. But their interpretation does not allow the γ-attenuation method to be considered a simple measuring method for void fraction. Author

N68-30581# Aeronautical Research Council (Gt. Brit.).
THE EFFECT OF NON-UNIFORM WALL TEMPERATURES ON SKIN FRICTION AND HEAT TRANSFER IN LAMINAR COMPRESSIBLE BOUNDARY LAYERS
T. Hughes (Ph.D. Thesis—London Univ.) 5 Oct. 1967 38 p refs
(ARC-29509; AD-670299)

The results obtained from exact numerical solutions to the laminar boundary layer equations are compared with those given by the approximate method of Luxton and Young and the comparison shows that the latter method may be used for cases involving non-constant wall temperatures. This satisfactory result arises essentially from the fact demonstrated by the calculations that the skin friction is relatively insensitive to wall temperature gradients. It is also shown from these results that there is a lag in the propagation of wall temperature changes through the boundary layer. In consequence the Stanton number is a heat transfer parameter of doubtful value in cases of non-uniform wall temperature. Author (TAB)

N68-30581# Aktiebolaget Atomenergi, Stockholm (Sweden).
THEORETICAL INVESTIGATION OF AN ELECTROGASDYNAMIC GENERATOR
Soeren Palmgren May 1968 35 p refs
(AE-324) CFSTI: HC$3.00/MF$0.65

In an electrogasdynamic generator a portion of the enthalpy of a high velocity gas flow is converted directly into electrical energy through forcing unipolar charge carriers against an electric field. In a first attempt we try to describe this process by use of a one-dimensional mathematical model with an adiabatic flow. An exact analytic equation is derived for this case. Assuming the interaction between the charge carriers and the gas to be a perturbation of the first order this equation can be solved analytically. The zero order perturbation, i.e. constant thermodynamic state of the flow, agrees with previous analyses. It is found that this is an adequate approximation for the linear model. A complete analysis of a cylindrical EGD generator must however take into account the radial electric field due to the space charge and the losses due to radial diffusion and mobility. A tentative investigation of a three dimensional axially symmetric model has therefore been made, including a survey and criticism of some earlier analyses. Author

N68-30588# Aeronautical Research Council (Gt. Brit.).
REVISION OF TURBULENT TO LAMINAR FLOW
V. C. Patel (Cambridge Univ.), and M. R. Head (Cambridge Univ.) 26 Jan. 1968 46 p refs
(ARC-29859; AD-670301)

It was shown experimentally that quite large departures occur from the universal inner-law velocity distribution in the presence of severe favourable pressure gradients in turbulent boundary layers and that these departures are associated with the

tendency for the turbulent boundary layer to revert to a laminar state. From the measurements it was found possible to deduce a criterion for the onset of reverse transition in terms of the mean shear stress gradient existing in the wall region of the flow. Experiments in fully-developed pipe and channel flows suggest that the proposed criterion may be quite generally applicable to all fully-turbulent shear flows. Author (TAB)

N68-30609# Aeronautical Research Council (Gt. Brit.).
THE INFLUENCE OF DENSITY GRADIENTS ON THE EFFECTIVENESS OF FILM COOLING
B. R. Pai (Imperial Coll. of Sci. and Technol.) and J. H. Whitelaw (Imperial Coll of Sci. and Technol.) 19 Feb. 1968 34 p refs
Its GTCC Combust. Sub-Comm. Paper No. 258
(ARC-29928; EHT/TN/8; AD-670300)

New measurements of the impervious-wall effectiveness are presented. These measurements were carried out using hydrogen, air, argon and Arcton 12 as the injected gas. The measurements demonstrate, quantitatively, that an increase in the density ratio leads to an increase in effectiveness for the same velocity ratio. The prediction method proposed by S. V. Patankar and D. B. Spalding has been tested against the present measurements and shown to be a convenient method in the region downstream of the immediate vicinity of the slot exit. Author (TAB)

N68-30624# Battis Atomic Power Lab., Pittsburgh, Pa.
TRANSPORT OF PARTICLES IN TURBULENT FLOW TO CHANNEL OR PIPE WALLS
S. K. Beal Apr. 1968 36 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-TM-765) CFSTI: HC $3.00/MF $0.65

An analysis of the deposition of particles entrained in turbulent flow is presented. The method predicts the deposition of particles ranging from molecular size to about 100 microns in diameter; results agree reasonably well with published data. Stokes–Einstein turbulent diffusion, and inertial effects are accounted for. In addition, the existence of an equilibrium concentration of particles close to the wall is postulated. Author (NSA)

N68-30641# Stanford Univ., Calif. Thermosciences Div.
AN EXPERIMENTAL STUDY OF TURBULENCE PRODUCTION NEAR A SMOOTH WALL IN A TURBULENT BOUNDARY LAYER
H. T. Kim, S. J. Kline, and W. C. Reynolds Jan. 1968 184 p refs
(Contract AF 49(638)-1278; Grants NSF GP-2720; NSF GK-1334)
(MD-20; AFOSR-68-0383; AD-669823)

Detailed study of the structure of a turbulent boundary layer near a smooth wall is presented including instantaneous values of: velocity profiles, fluctuation data, and turbulence production rates. It is shown that essentially all the turbulence production occurs during bursting times. The details of the bursting process are described in three stages: low-speed streak lifting, oscillatory growth, and breakup. It is shown that the streak-lifting creates an unstable (inflexional) region in the instantaneous velocity profile. This unstable region is followed, in the downstream flow, by oscillatory growth and breakup. Short duration energy spectra, auto-correlation data, fluctuation data in mean value and for bursting and non-bursting times, detailed photos of the flow processes, and comparison of measured frequencies with calculated unstable frequencies all suggest that the process of turbulence production near smooth walls is due to the formation of a local instability of the Kelvin-Helmholz type arising from the interaction of the wall model with the outer flow, that is from low-speed streak lifting. Author (TAB)

N68-30642# Technische Hochschule in Wein (Austria). Institut fuer Experimental Physik.
DYNAMICS OF LIQUIDS Final Scientific Report, 1 Nov. 1964–31 Oct. 1967
P. Weinzierl 15 Dec. 1967 92 p refs
(Contract AF 61(052)-845)
(AFOSR-68-1041; AD-669817)

A study of liquid dynamics was undertaken by means of absorption or scattering of recoilless emitted gamma-rays. The 46.5 keV transition in 183W with 60.0000026 eV line width is chosen. A complete Mossbauer absorption setup including a 0.5 m/s constant acceleration velocity drive, time-mode registration and a Ge(Li)-detector system was constructed. It was operated with excellent stability for transmission experiments. As all efforts to use WF6 as liquid tramission sample failed due to its unexpectedly low Debye-temperature, measurements on various other tungsten (VI)-halides were carried out. But eutectic mixtures of alkali-tungstates seem to offer better chances for the transmission experiment. For the scattering experiment development on a motor drive and a high speed loudspeaker drive was carried out. Operation up to 3 m/s drive velocity can now be realized. Instead of a primary gamma-energy selection by a bent crystal spectrometer a very selective resonance detector system was chosen using a pill box-type proportional counter and a special electronic suppression device for high energy background. Author (TAB)

N68-30644# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
SOME RESULTS OF VELOCITY FLUCTUATION MEASUREMENTS IN THE INITIAL SECTION OF AN AXISYMMETRIC JET
L. I. Ilizarova 26 Mar. 1968 19 p refs Transl. into ENGLISH from Prom. Aerodinamika no. 27, 1966 p 111–120
(Contract NOW-62-0604-c)
(TG-230-T552; AD-669937)

A turbulent axisymmetric jet was investigated to determine the axial, radial and tangential components of the fluctuating velocity as well as the axial and radial components of the velocity correlation coefficients at a given point. Also determined were the symmetric and asymmetric correlation coefficients and the transverse turbulence scale. The jet was 150, 440 and 2200 mm in diameter; measurements were taken in the initial section (submerged jet) where the boundary layer is two-dimensional. The results of measurements are shown graphically as families of curves describing the mean velocity, the turbulence intensity, the fluctuating velocity component and various cross plots of these parameters. Author (TAB)

N68-30673# Von Karman Inst. for Fluid Dynamics, Rhode Saint-Genese (Belgium).
ON THE PRESSURE DECAY RATE IN THE LONGSHOT RESERVOIR
Kurt R. Enkenhus 1967 46 p refs
(VKI-NT-40) CFSTI: HC $3.00/MF $0.65

In the longshot free piston shock tunnel, the gas compressed by the piston is trapped in a reservoir. The adiabatic pressure decay of the dense nitrogen test gas due to sonic flow through the nozzle throat is calculated for a perfect gas and for a real gas. Analytical expressions are obtained for the pressure decay rate of a perfect gas and for an Abel–Noble gas. Charts are presented which permit the pressure decay rate to be approximately predicted over a wide range of operating conditions with nitrogen. Author

N68-30729# Von Karman Inst. for Fluid Dynamics, Rhode Saint-Genese (Belgium).
THEORETICAL PERFORMANCE STUDY OF THE FREE-PISTON SHOCK TUBE
K. R. Enkenhus Jan. 1968 46 p refs
(VKI-TN-42) CFSTI: HC $3.00/MF $0.65

Formulas and charts are presented for predicting the performance of a free piston shock tube using helium or hydrogen as the driver gas and real air as the test gas. The use of a piston to adiabatically compress the test gas in what is otherwise a conventional shock tube affords the practical possibility of obtaining shock Mach numbers above 40 in air, with temperatures well above 12,000°K behind the incident shock. Author

N68-30743# California Univ., Berkeley. Operations Research Center.
CONTRIBUTIONS TO THE THEORY OF EXTREME VALUES
Robert Harris. Apr. 1968 46 p refs
(Contract Nonr-3656(18); Grant NSF GK-1684)
(ORC-68-9; AD-670485)

Extreme value distribution laws are obtained for the lifetimes of multi-component systems with replaceable components, under various assumptions on the asymptotic relationship between number of components in the system and number of spare components. Results are given for limiting distribution laws of order statistics from nonhomogeneous samples and samples of random size, and applied to the superposition of renewal processes. An attempt is made to put extreme value theory into a general framework using the notion of a coherent structure, and some new results utilizing this idea are presented. Author (TAB)

N68-30826# Stanford Univ., Calif. Div. of Engineering Mechanics.
A NUMERICAL SOLUTION FOR THE LAMINAR WAKE BEHIND A FINITE FLAT PLATE
Allen Plotkin and I. Flugge-Lotz. Jan. 1968 99 p refs
(Contract AF 49(638)-1385)
(AFOSR-68-1018; TR-179; AD-669581)

A numerical solution is presented for the laminar, two-dimensional viscous, incompressible wake behind a finite flat plate. The plate is infinitely thin and is aligned parallel to a uniform stream. The Reynolds number based on plate length is assumed large enough to allow the formation of boundary layers on the sides of the plate. The upstream influence of the trailing-edge disturbance necessitates solving the complete Navier-Stokes equations in the trailing-edge region. The aim of the investigation is to calculate an improved first approximation to the solution in this region for large values of the Reynolds number. The elliptic equations define a boundary-value problem. A finite-difference solution to equations which closely approximate the Navier-Stokes equations is obtained in a rectangular region which includes the trailing edge. A relaxation-type procedure is used. Weighted differences, which combine backward and central differences in equal proportion, are introduced to provide the upstream influence in the scheme. The nonlinear partial differential equations are replaced by linear difference equations and iteration is used until the solutions converge. Solutions are obtained for Reynolds numbers larger than 100,000. A complete description of the flow field is provided in the rectangle and downstream wake except in a very small region surrounding the trailing edge. Author (TAB)

N68-30847# Michigan Univ., Ann Arbor. Inst. of Science and Technology.
ACCELERATION OF A HYPERSONIC BOUNDARY LAYER APPROACHING A CORNER
George R. Olsson and Arthur F. Messiter. May 1968 98 p refs
(Contract DAHC15-67-C-0062)
(Rept.-8416-13-T; AD-670189)

An asymptotic description of the acceleration of a laminar hypersonic boundary layer approaching a sharp corner is obtained. The description assumes small interaction with the outer inviscid flow. Viscous forces are neglected except in a thin sublayer. The initial part of the expansion takes place over a distance O(M sub e differential), where M sub e is the external Mach number, and differential is the boundary-layer thickness. Here the transverse pressure gradient is small, and a solution can be obtained analytically. Within a distance O(differential) from the corner, the effect of streamline curvature is essential, and a numerical solution is obtained by the method of integral relations for a single strip. The solution for surface pressure is compared with experimental results for a particular case, and an approximate velocity profile at the corner is calculated. Possibilities for improving the accuracy of the calculation, both by refining the numerical procedure and by including higher order effects, are considered. Author (TAB)

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N68-29586# Harvard Univ., Cambridge, Mass. Environmental Design Center.
HYPER-SURFACES AND GEODESIC LINES IN 4-D EUCLIDEAN SPACE
C. Ernesto S. Lindgren. 17 May 1968 17 p refs
(Contract N00014-67-A-0298-0004)
(TR-17; AD-669263)

The paper introduces general concepts in the generation of hyper-surfaces in 4-D euclidean space, defines curvature and proposes a solution for the determination of the geodesic line through two points. Author (TAB)

N68-29621 Missouri Univ., Columbia.
DIURNAL WIND OSCILLATIONS ABOVE A LOW LEVEL JET
Owen Edward Thompson (Ph.D. Thesis) 1966 160 p
Available from Univ. Microfilms: HC $7.40/MF $3.00 Order No. 67-2879

The phenomenon of diurnal oscillations in the wind field from the surface of the earth to the tropopause is investigated from a theoretical standpoint. The perturbation equations of motion and continuity are solved for four different cases of geostrophic wind and density distribution in a general model. Each of the cases demonstrate that super- and sub-geostrophic winds in these profiles may arise due to perturbations super-imposed on the basic geostrophic field that oscillate in response to the boundary layer oscillation. In addition, two cases show that horizontal jet like wind profiles can result from perturbations on a linear horizontal geostrophic wind profile. A mechanism is proposed for the initiation and maintenance of the upper level oscillations. It is argued that horizontal convergence in the boundary layer in a region where the actual wind is sub-geostrophic with a cross isobaric component sets up a vertical divergence which, with the boundary condition that the vertical perturbation velocity be zero at the earth's surface, gives a maximum vertical velocity above the boundary layer. Dissert. Abstr.

N68-29622 Stanford Univ., Calif.
THE REMANENT MAGNETIZATION, COOLING HISTORY, AND PALEOMAGNETIC RECORD OF THE MARYS PEAK SILL, OREGON
Howard Charles Clark, Jr. (Ph.D. Thesis) 167 67 p
Available from Univ. Microfilms: HC $3.80/MF $3.00 Order No. 67-11025

A paleomagnetic investigation of the Marys Peak sill demonstrates a relationship between this intrusion's cooling history and its remanent magnetization. Although paleomagnetism has contributed much to the analysis of geomagnetic secular variation, the studies have generally been limited to sampling discrete points in time the intervals between which are not precisely known. In the case of Marys Peak, the association of the cooling history and remanent magnetization may be used to estimate the length of the paleomagnetic record acquired as the sill cooled. That is, an intrusive body would cool slowly, and under favorable conditions acquire a thermoremanent magnetization (TRM) as the Curie temperature isotherms migrated from the outside margins inward. A suitable mathematical model of the cooling history permits the transformation from the geometrical record of remanent magnetization in the sill to a time record of the geomagnetic field that existed when the sill cooled. Dissert. Abstr.

N68-29706*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
EFFECT OF RANDOM ATMOSPHERIC REFRACTION ON OPTICAL SATELLITE OBSERVATIONS
K. Lambeck 15 Mar. 1968 34 p refs
(Grant NsG-87)
(NASA-CR-95809; SAO-Special Rept.-269) CFSTI: HC $3.00/MF $0.65 CSCL 04A

The effects on optical satellite observations of image motion resulting from microturbulence in the troposphere are studied. A formulation, based on theoretical and heuristic considerations as well as on limited observational data, enables the magnitude of the image motion to be estimated as a function of lens aperture, exposure time, and zenith distance. Author

N68-29723# Stanford Research Inst., Menlo Park, Calif.
VERTICAL-INCIDENCE IONOSPHERIC DATA: THAILAND Ionospheric Data Report, Apr. 1966–Mar. 1967
Bernadine E. Frank and George H. Hagn Dec. 1967 505 p refs
(Contract DA-36-039-AMC-00040(E); ARPA Order 371)
(AD-669601)

The Granger Model 911 ionospheric sounder systems were operated during 1966 and 1967 at six sites in Thailand ranging between about 7 and 19 degrees North geographic latitude (geomagnetic field dip angles from 5 degrees S to 20 degrees N). This report presents the results from scaling the vertical-incidence ionograms obtained for foF2, hF2, foF1, hF1, foEs, hEs, and percentage of occurrence of Es and spread F. A comparison is made between foF2 values scaled from the Bangkok C-2/3/4 sounder and the Granger sounder for two brief periods--6 April through 7 May 1966, and 1 June through 19 June 1967--when both equipments were operated at the same site. Author (TAB)

N68-29740# Max-Planck-Institut fur Aeronomie, Lindau Uber Northeim (West Germany). Institut fuer Stratosphaerenphysik.
DESCRIPTION OF A NEW OZONE RADIOSONDE AND INVESTIGATION OF AIR MOVEMENTS IN THE LOWER STRATOSPHERE [UEBER EINE NEUE OZONRADIOSONDE UND UNTERSUCHUNG VON LUFTTRANSPORTEN IN DER UNTEREN STRATOSPHAERE]
Peter Fabian 1967 63 p refs In GERMAN
(Rept.-28/1967) CFSTI: HC $3.00/MF $0.65

An optical ozone radiosonde based on the ozone absorption in the Chappuis band of the visible light spectrum is described. During the ascent the instrument measures continuously the intensity of the direct sunlight in two regions of the spectrum, selected by interference filters, one at the maximum of the Chappuis band, the other around 4000 Å where the ozone absorption can be disregarded. The intensity ratio of both spectral regions is compared with the theoretical value resulting from the Rayleigh scattering law. The result enables to calculate the ozone profile in relation to altitude. Ozone profiles for 25 ascents are reproduced. Statistical methods are used to investigate connections between ozone content and geographical origin of the air. It is shown that the latitude through which the measured air has travelled during the last six days presents a firm correlation with the total amount of ozone. An attempt is made to interpret these results by a large-scale ozone circulation. Author (ESRO)

N68-29753# Picatinny Arsenal, Dover, N. J. Data Processing Systems Office.
CONTOUR, A FORTRAN PROGRAM TO PRODUCE CONTOUR MAPS FROM A MATRIX
Forrest McMains Oct. 1967 38 p
(PA-TM-1796; AD-669485)

This memorandum describes a Fortran program for producing contour maps from matrix data. It has been written for use with the IBM 360-65 Computer and the Calcomp Plotter System. Author (TAB)

N68-29756# Max-Planck-Institut fur Aeronomie, Lindau Uber Northeim (West Germany). Institut fuer Stratosphaerenphysik.
RECORDING AND ANALYSIS OF AURORAL GEOMAGNETIC PULSATIONS, AND A COMPARISON WITH BREMSSTRAHLUNG MEASUREMENTS [REGISTRIERUNG UND ANALYSE ERDMAGNETISCHER PULSATIONEN DER POLARLICHTZONE, SOWIE EIN VERGLEICH MIT BREMSSTRAHLUNGSMESSUNGEN]
Klaus Wilhelm 1966 44 p refs In GERMAN
(Rept.-27/66) CFSTI: HC $3.00/MF $0.65

An arrangement of two magnetometers for recording geomagnetic pulsations is described. It has been used in the auroral zone in conjunction with a very low speed tape recorder while simultaneous X-ray measurements were made by balloon in the stratosphere. The tapes have been analyzed in a sonagraph which is described. Results gained are discussed. Temporal connection between the pulsation activity and the Bremsstrahlung is discussed. Special attention is paid to pc 1 type pulsations and their connection with Bremsstrahlung during the night and day light hours. Author (ESRO)

N68-29770*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE POLAR UPPER ATMOSPHERE AND AURORA
Kaichi Maeda and George Ishikawa (Meteorol. Res. Inst.) May 1968 68 p refs
(NASA-TM-X-63280; X-641-68-198) CFSTI: HC $3.00/MF $0.65 CSCL 04A

The following three topics in the physics of the polar upper atmosphere and their latest developments were reviewed: (1) Winter anomalies of the polar ionosphere and their interpretations. (2) Aurorae and some related phenomena, and (3) Noctilucent clouds. In each topic, there are still unsolved problems and controversies that could be settled by direct observations by means of rockets and artificial satellites. The importance of rocket-soundings in the altitude range between two limits, i.e., the one around 40 km for balloons and the other around 100 km for artificial satellites, is emphasized for future developments in the physics of the earth's upper atmosphere. Author

N68-29787 Rice Univ., Houston, Tex.
VIRGIN BANK: CORRELATION OF MAGNETISM AND GRAVITY WITH GEOLOGY
Vincent Paul Augustin Renard (Ph.D. Thesis) 1967 174 p
Available from Univ. Microfilms: HC $8.00/MF $3.00 Order No. 67-13114

Magnetic and gravity measurements on the Virgin Bank are presented and interpreted in the light of available seismic.

bathymetric, paleomagnetic and geologic data. Five physiographic zones are outlined on the shelf from their typical magneto-bathymetric character. These zones appear as surface expression of deeper structural features. The magnetic map delineates four main anomalous patterns. Two dimensional Fourier analysis is used to reduce the anomalies to their poles and to convert them into a basement surface relief. Models are also fitted to the data. The basement surface and the Virgin Islands batholith are shown to be responsible for the main magnetic anomalies. Dissert. Abstr.

N68-29847*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
NITRIC OXIDE IN THE MESOSPHERE AND ITS VARIATIONS
A. P. Mitra Jul. 1968 27 p refs Presented at the COSPAR-IAMAP Joint Session on Probl. of the Winter Atmosphere from the Stratosphere to the Turbopause, COSPAR Assembly, Tokyo, May 1968
(NASA-TM-X-63286; X-615-68-262) CFSTI: HC $3.00/MF $0.65 CSCL 04A

The distributions, seasonal variations and the resulting ionospheric implications of mesospheric nitric oxide are discussed. We first consider the principal features of an average distribution for this constituent that would be consistent with photochemical considerations and with the diurnal and solar cycle variations in D region ionization and the relative abundances of the molecular ions NO^+ and O_2^+. We then consider the extent to which the average profile may vary seasonally in middle latitudes. Large winter enhancements occur in NO concentrations at all D region heights above about 70 km due to the winter warming at these heights. The enhanced region is limited roughly between 70–90 km, the lower limit being controlled by the rapid loss of nitric oxide through ozone. NO production through the ionic reaction $O^+_2 + N_2 \rightarrow NO^+ + NO$ does not appear to be significant at any height. Ionospheric implications of these NO distributions are also discussed. Author

N68-29849# Royal Aircraft Establishment, Farnborough (England).
AIR DENSITY AT HEIGHTS NEAR 190 KM IN 1966–67, FROM THE ORBIT OF SECOR 6
D. G. King-Hele and Janice Hingston Nov. 1967 35 p refs
(RAE-TR-67285) CFSTI: HC $3.00/MF $0.65

The air density at a height of 191 km between 14 June 1966 and 5 July 1967 has been evaluated by analysing the orbit of the satellite Secor 6 (1966–51B). The 154 values of density obtained show that nearly all geomagnetic disturbances are accompanied by increases in density, of larger magnitude than expected. Surprisingly, however, the strong 27-day recurrence tendencies in solar activity, as represented by the 10.17-cm radiation energy, are quite absent from the density variations. When the effect of the day-to-night variation is removed, the most important variation in air density at 191 km during 1966–67 is found to be a semi-annual oscillation, with the maximum density, in October 1966 and April 1967, exceeding the minimum, in July 1966 and January 1967, by a factor of 1.45. This semi-annual variation, which is very similar in form to that found at a height of 1130 km from Echo 2, has during 1966–67 displaced solar activity as the main source of atmospheric variation at heights near 200 km. Author (ESRO)

N68-29868*# Volt Technical Corp., Washington, D. C.
ISOPHOTS OF ZODIACAL LIGHT AND ITS TERRESTRIAL COMPONENT
N. B. Divari, N. I. Komarnitskaya, and S. N. Krylova Greenbelt, Md. NASA Goddard Space Flight Center 25 Jul. 1968 9 p refs Transl. into ENGLISH from Astron. Vestn. (Moscow), v. 2, no. 2, 1968 p 102–107
(Contract NAS5-12487)
(NASA-CR-95833; ST-AA-ID-10731) CFSTI: HC $3.00/MF $0.65 CSCL 04A

The effect of the Moon on the brightness distribution of zodiacal light cones was revealed on the basis of an analysis of zodiacal light isophots obtained under various latitudes, and it was concluded that the zodiacal light contains a terrestrial component due to dust concentrated either in the form of a ring at a certain distance from the Earth, or in the vicinity of the libration points of the Earth–Moon system, or in the vicinity of the lunar orbit. Author

N68-29927 Texas A&M Univ., College Station.
THE EFFECT OF POROSITY ON SHEARING RESISTANCE AND THERMAL CONDUCTIVITY FOR AMORPHOUS SOILS IN VACUUM
Ronald Hobart Waters (Ph.D. Thesis) 1967 175 p
Available from Univ. Microfilms: HC $8.00/MF $3.00 Order No. 67-9816

In support of the ensuing requirements for basic knowledge of the engineering properties of lunar surface materials, a study was made of the relationship between thermal conductivity, porosity and shearing strength for amorphous silicate materials in a high vacuum (to 10^{-8} torr) environment. The basic objective of the study was to evaluate the potential of utilizing thermal conductivity measurements to delineate a soil's porosity or shear strength in a high-vacuum environment. Amorphous granular packings composed of glass beads and granules of volcanic glass were selected as laboratory soil models. The granules of volcanic glass formed four test soils in the 56–96% porosity range and were the object of the major effort to correlate thermal conductivity measurements to porosity and shear strength. The vacuum thermal conductivity of the test materials was determined by a "transient state" thermal probe constructed as a part of this research. The results of the vacuum correlation of thermal conductivity, porosity and shear characteristics for the 16–30 mesh sieve size volcanic granules show that thermal conductivity measurements are capable of discerning porosity to within ±5% and the angle of shearing resistance to ±3°. Dissert. Abstr.

N68-30006# Army Electronics Labs., Fort Monmouth, N. J.
ATMOSPHERIC ELECTRICITY PROGRAM FLAGSTAFF, ARIZONA, PART 3
William C. Barr Mar. 1968 19 p refs
(ECOM-2945; AD-669590)

The three components of the electric field have been measured in flights past a series of isolated thunderstorms and electrically-active cumulus clouds. Many of the clouds studied have field patterns that appear similar to those that would be experienced if the cloud were a point charge. If the cloud is assumed to be a point charge in these flights, then the magnitude and polarity of the charge can be calculated. Author (TAB)

N68-30024# Saint Thomas Univ., Houston, Tex. Inst. for Storm Research.
THE POWER SPECTRUM IN THE ATMOSPHERE BELOW MACROSCALE Final Report, Mar.–Oct. 1967
Joseph L. Goldman Mar. 1968 41 p refs
(Grant DA-AMC-28-043-67-G5-F)
(ECOM-367G5-F; AD-669678)

The classical analysis of power spectrum in the atmosphere by Van der Hoven has been reexamined with doubt cast on the representativeness of the spectral gap in the mesoscale. Theoretical considerations about the scale of eddies that contribute to variance in the horizontal wind tend toward a distribution of energy that decreases with frequency. In fact, the log-log distribution of variance per cycle as a function of frequency produces a slope approximating the expected -5/3 that coincides with the cascade of energy expected in the higher frequencies. Computations of the spectrum using new wind data with no long term gaps seem to confirm suspicions that Van der Hovens spectral gap in the mesoscale may not be valid. Author (TAB)

N68-30025# Army Electronics Labs., Fort Monmouth, N. J.
ATMOSPHERIC ELECTRICITY PROGRAM, FLAGSTAFF, ARIZONA, PART 2
E. M. Frisby and J. C. Kline Feb. 1968 21 p
(ECOM-2941; AD-669591)

Part II of the 1967 Flagstaff, Arizona Report series deals with the development at the Atmospheric Sciences Laboratory, Fort Monmouth, N. J., of several electrometers for surface use and the analysis of observations obtained from their deployment. These observations were made during June and July 1967 in the Fort Monmouth, N. J. area as well as in the vicinity of Flagstaff, Arizona. The report therefore includes comparisons between surface atmospheric electricity readings taken under differing meteorological conditions at two locations, one at sea level, the other at 7000 feet, and an attempt to relate an index of atmospheric stability to various types of electrometer readings. Author (TAB)

N68-30084# Dartmouth Coll., Hanover, N. H. Radiophysics Lab.
STUDIES OF SPATIAL IRREGULARITIES IN THE IONOSPHERE AND THEIR VARIATIONS WITH TIME Final Report, 1 May 1964–31 Aug. 1967
Millett G. Morgan 28 Feb. 1968 39 p refs
(Contract AF 19(628)-4059)
(AFCRL-68-0125; AD-670185)

The AFCRL airborne ionosonde program, and the completion of development and construction of equipment for the production of oblique-path ionograms for studying travelling ionospheric disturbances. This equipment was installed and operated in a three-station network based at Hanover, N.H., and the analysis of observations made with the network is described in a graduate student thesis which is incorporated here-in by reference. A comparison of the observations with simultaneous observations on a three-frequency, PPI display, backscatter sounder, also located at Hanover, N.H., is described in a second graduate student thesis which is also incorporated here-in by reference. The development of a new vertical-incidence, sweep-frequency ionosonde capable of continuous, unattended operation is described. Author (TAB)

N68-30101# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVASION OF PROTONS IN POLAR AURORAE [VTORZHENIE PROTONOV V POLYARNYKH SIYANIYAKH. 1: EKSPERIMENTALNYE REZULTATY]
Yu. I. Gal'perin 18 Aug. 1967 28 p refs Transl. into ENGLISH from Polyarnyye Siyaniya i Svecheniye Nochnogo Veba, Sb. Statei (USSR), no. 10, 1963 p 70–79
(FTD-MT-65-478; AD-669513)

The article is in two main sections: a discussion of experimental results and the theory of auroral hydrogen line glow. In the first of these sections the author considers such factors as the morphology of proton precipitation, intensity distribution as a function of height, hydrogen line profiles, the Balmer attenuation decrement, hydrogen line intensity levels and correlations with emissions of other specific character and direct measurements of proton precipitation into the auroral atmosphere. In the second part of the article, which deals with theoretical considerations on the glow of hydrogen lines under auroral conditions, the author has discussed the dependence of glow on the velocity of the particle and the role of protons in the excitation of auroral glow. Theoretical considerations on proton flux anisotropy and corresponding cross-sections are briefly reviewed. Author (TAB)

N68-30121# Polish Academy of Sciences, Warsaw. Inst. of Geophysics.
LATITUDE VARIATIONS
1968 124 p refs In POLISH
(Rept.-22) CFSTI: HC $3.00/MF $0.65

Three papers deal with various aspects of determining latitude variations over extended time periods. Accuracy of the clocks and chronographs used for the time observations is considered, and attention is given to the instrumentation and human errors involved in making the measurements. Numerous tables and graphs depict the results. Transl. by G.W.

N68-30384# Mainz Univ. (West Germany). Meteorological-Geophysical Inst.
RESEARCH ON ATMOSPHERIC OPTICAL RADIATION TRANSMISSION Interim Scientific Report, 1 Dec. 1966–30 Nov. 1967
K. Bullrich, W. Blaettner, T. Conley, R. Eiden, G. Haenel et al Jan. 1968 163 p refs
(Contract F61052-67-C-0046)
(ISR-6; AFCRL-68-0186; AD-670210)

Contents: Measurements of the spectral distribution of the sky radiation and of the radiation reflected by the ground as well as their degrees of polarization at Alamogordo, N.M., USA; Experimental and theoretical investigations into the spectral and angular dependence of reflectivity and the degree of polarization of reflected radiation of various soil types; The influence of the shape of the aerosol particles on their collection in a jet impactor; Contribution to the polarization of the sky radiation; A portable scattering function meter; The influence of second order scattering on the sky radiation and on the radiation emerging from the earths atmosphere under the assumption of a turbid atmosphere. Author (TAB)

N68-30407# Air Force Cambridge Research Labs., Bedford, Mass. Ionospheric Physics Lab.
A PROPOSED INDEX FOR MEASURING IONOSPHERIC SCINTILLATION
Herbert E. Whitney and Chester Malik Mar. 1968 22 p refs *Its* Environ. Res. Papers, no. 284
(AFCRL-68-0138; AD-669805)

Signals from radio star sources and satellites are regularly used for studying ionospheric irregularities. Amplitude and phase deviations can be imposed on the signals from these sources as they traverse the ionosphere. A parameter frequently used to describe the magnitude of this scintillation effect is scintillation index. An experiment was designed to correlate various methods of making scintillation measurements; observations were made at 40 MHz using the ionospheric beacon, S-66. It is shown that when the law of the receiver detector is known, a conversion method allows comparison of data and statistics on scintillation index. A simplified method of scaling scintillation index is described. The accuracy of the simplified method is determined by a comparison with measurements of scintillation index by machine computation. Author (TAB)

N68-30408# Weapons Research Establishment, Salisbury (Australia).
THE APPLICATION OF AUTOMATIC DATA PROCESSING TECHNIQUES TO THE INVESTIGATION OF THE SCINTILLATION OF SATELLITE SIGNALS
D. G. Singleton Jan. 1968 42 p refs
(WRE-TN-APD-11) CFSTI: HC $3.00/MF $0.65

The availability of satellite scintillation data, obtained by the observation of the Beacon Explorer satellites at a number of sites throughout Australasia, makes it possible to examine a number of features of the scintillation phenomenon. These include the sizes and shapes of both the individual scintillation producing irregularities and the groups or patches in which they occur, as well as their overall temporal and spatial distributions and their possible association with other geophysical effects. A group of fourteen interrelated computer programmes is described. This forms an automatic data processing system which has been used to investigate these aspects of satellite scintillations. Author

N68-30471# Japan Atomic Energy Research Inst., Ibaraki.
SECULAR VAIATION OF ATMOSPHERIC RADIOCARBON CONCENTRATION
Kunihiko Kigoshi (Gakushuin Univ.) Mar. 1968 26 p refs Transl. into ENGLISH from Nippon Kagaku Zasshi (Tokyo), v. 87, no. 3, Mar. 1966 p 209–220
(NSJ-TR-104) CFSTI: HC$3.00/MF$0.65

The variation in atmospheric radiocarbon concentration during the last 1800 years was measured by the use of a giant tree grown on Yaku Island in southern part of Japan. Details are given on the experimental procedures and the nature of carbon atoms in a tree ring which was used as a representative sample of atmospheric carbon dioxide in past time. The results of measurements showed a 2% decrease of radiocarbon concentration during the past 1800 years. A general figure of the observed secular variation in atmospheric radiocarbon concentration agrees with a computed variation based on the variation in geomagnetic field strength in past time. The possible variation in the atmospheric radiocarbon caused by variation of climate, and variation of the nature of air masses were also discussed. An estimation of the effects of temperature on carbon cycle and atmospheric radiocarbon concentration showed a possible decrease of the atmospheric radiocarbon concentration of 0.5% per 1°C increase of temperature. A systematic difference between radiocarbon concentrations in Yaku Sugi and Sequoia gigantea from California seems to suggest a lower radiocarbon concentration in the oceanic air masses than the continental air masses. Author

N68-30489# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATIONS OF GEOMAGNETISM AND EARTH CURRENTS [ISSLEDOVANIYA GEOMAGNETIZMA I ZEMNYKH TOKOV]
V. A. Troitskaya 27 Jul. 1967 10 p Transl. into ENGLISH from Vestn. Akad. Nauk SSSR (Moscow), no 8, 1965 p 90–91
(FTD-HT-67-430; AD-670108)

A summary is given of the activities of the All-Union Conference on geomagnetism and earth currents, which was held in Moscow 13 April to 21 April 1965. TAB

N68-30499# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Munich (West Germany). Inst. fuer Flugfunk und Mikrowellen.
THE USE OF A 35 GHZ RADIOMETER FOR MICROWAVE GROUNDMAPPING [DIE VERWENDUNG EINES 35-GHZ-RADIOMETERS ZUR KARTOGRAPHIE VOM FLUGZEUG AUS]
F. Schlude May 1968 29 p refs In GERMAN; ENGLISH summary
(DLR-MITT.-68-10; DVL-745) CFSTI: HC$3.00/MF$0.65

A 35 GHz radiometer is used for mapping selected areas with characteristic water-land contrasts by pencil-beam line-scanning and by flying a parallel strip flight program. The report begins with a short compilation of basic facts about passive microwave mapping. Then the set-up of the airborne part of the mapping system, its calibration, and the data processing are described in detail. Four thermal maps of different target-areas are shown as results. They indicate the resolution capability of the relatively simple mapping system as concerns regions containing larger lakes or an accumulation of many small lakes. Author

N68-30544# Joint Publications Research Service, Washington, D. C.
OCEANOGRAPHY
In its Soviet-Bloc Res. in Geophys., Astronomy, and Space, No. 184 22 Jul. 1968 p 27–36 refs (See N68-30541 18-34)

Oceanographic research is reported in selected news articles and abstracts of scientific papers taken from the Soviet-bloc literature. Note is made of a symposium on sea diffusion, Pacific Ocean waters in the Arctic basin, and an atlas of equatorial Atlantic and Caribbean areas, books on hydrological processes, and Pacific Ocean plankton. Abstracts cover sound scattering by nonuniformities in the ocean floor, means of studying the temperature field of the sea surface, the atmosphere/sea surface interface, determining water temperature, and a tidal map. M.W.R.

N68-30545# Joint Publications Research Service, Washington, D. C.
TERRESTRIAL GEOPHYSICS
In its Soviet-Bloc Res. in Geophys., Astronomy, and Space, No. 184 22 Jul. 1968 p 37–46 refs (See N68-30541 18-34)

News and abstracts of scientific articles on terrestrial geophysics are taken from the Soviet-bloc literature. Crustal movements, macroseismic research, archeology and magnetism, and earthquakes are among the topics of the news reports. Velocity of elastic waves in crystalline rocks, magnetic anomalies of the Transcarpathian foredeep, upper mantle characteristics in the Pacific Ocean transition zone, paleomagnetism and continental stability, and permafrost strata in the earth are considered in the abstracts. M.W.R.

N68-30546# Joint Publications Research Service, Washington, D. C.
UPPER ATMOSPHERE AND SPACE RESEARCH
In its Soviet-Bloc Res. in Geophys., Astronomy, and Space, No. 184 22 Jul. 1968 p 47–67 refs (See N68-30541 18-34)

Upper atmosphere and space research as reported in the Soviet-bloc literature is reviewed in a number of news articles and abstracts of scientific papers. Recent Soviet space exploits are summarized, an announcement of the launchings of Cosmos 225, 226, 227, and 228 is included; and the future of satellite communications is examined. Other news reports deal with the effects of artificial radiation belts on radio communications, manned spacecraft landing, a conference on Soviet-bloc countries cooperating in space research, and an abridged space bibliography. Abstracts deal with physical conditions near the mesopause, properties of the fluctuations of ultrashort wave signals, and data from the Venus 4 planetary probe. M.W.R.

N68-30573# Stanford Research Inst., Menlo Park, Calif.
ATMOSPHERIC RADIO NOISE DATA BANGKOK, THAILAND Geophysical Data Report, Dec. 1967–Feb. 1968
Rangsit Chindahporn and Ponsak Buasri May 1968 22 p
(Contract DA-36-039-AMC-00040(E); ARPA Order 371)
(AD-670052)

Measurements of atmospheric radio noise are being made by the Electronics Laboratory of the Military Research and Development Center (MRDC-EL), a joint Thailand-United States organization in Bangkok. The noise-measuring equipment is located near the village of Laem Chabang in order to minimize interference from man-made noise. Four frequencies, either in the MF and HF bands or in the VLF and LF bands, may be recorded simultaneously for 30 minutes. The extent of the variation of the noise power from day to day at a particular hour of the day can be determined from the upper and lower decile values of Fa. Time-block median values of noise are tabulated on a seasonal basis and are obtained by averaging all month-hour medians for the four hours of the day within the three-month period. The results of the noise measurements at MF and HF for the months December 1967, January and February 1968, are also given. Author (TAB)

N68-30615# Signals Research and Development Establishment, Christchurch (England).
OBSERVATIONS OF TROPOSPHERIC SCATTER PATH LOSS AT C-BAND AND METEOROLOGICAL CONDITIONS IN CYPRUS
T. K. Fitz Simons Dec. 1967 26 p refs
(SRDE-67021; AD-670419)

The received carrier level of a C-band tropospheric scatter radio link in Cyprus was monitored for one year. The annual median value of path loss was compared with that obtained by various prediction methods. None of the methods was found to be accurate. Meterological data, which enabled the radio refractivity to be calculated, was also obtained during the course of the trial. A good correlation was found to exist between the path loss and refractivity at the earths surface and also with the height of the 500 nbar surface. However the path loss and upper air values of refractivity were found to be uncorrelated. It is concluded that the standard methods used for troposcatter path calculations are not satisfactory for predictions of loss in climates that differ appreciably from the temperate continental type. Author (TAB)

N68-30647# Aerojet-General Corp., El Monte, Calif. Space Div.
PASSIVE MICROWAVE MEASUREMENTS OF SNOW, SOILS AND SNOW ICE WATER SYSTEMS Technical Report, 1 Jan.–15 Nov. 1967
A. T. Edgerton, R. M. Mandl, G. A. Poe, J. E. Jenkins, F. Soltis et al. 15 Feb. 1968 363 p
(Contract Nonr-4767(00))
(SGD-829-6; TR-4; AD-669923)

The report summarizes field and laboratory investigations conducted to determine the microwave emission characteristics of a number of natural materials. These experiments demonstrate a useful relationship between the microwave brightness temperature and moisture content of soils and sediments. Small changes in soil moisture content can be measured by means of microwave radiometry. Other experiments have shown that multifrequency microwave measurements can provide an indication of the particle or fragment size distribution of exposed sediments. Laboratory measurements of ice-water systems demonstrate that definite relationships exist between the microwave temperatures and thickness of ice layers. Experiments were conducted with ice formed from both fresh and ocean water. Author (TAB)

N68-30684# Aeronautical Chart and Information Center, St. Louis, Mo.
TERRAIN EMBOSS. ITS APPLICATION TO SHADED RELIEF PRODUCTION BY RELIEF MODEL PHOTOGRAPHY
Walter J. Luber Dec. 1967 41 p refs Revised ed.
(ACIC-TR-104, Rev.; AD-669819)

A simplified hand-tooling technique for model making, developed at the Aeronautical Chart and Information Center for the primary purpose of improving production of shaded relief portrayal on USAF charts. Basic concepts and operational procedure are discussed and examples of models and printings are illustrated. A general updating is reflected in this revised edition, highlighted by improved tooling technique and examples of types of relief formations. During the three year period since the initial publication of this report hundreds of embossed relief models have been produced to service shaded relief and other chart requirements. Author (TAB)

N68-30709# Westinghouse Electric Corp., Boulder, Colo. Environmental Science and Technology Dept.
WORLD-WIDE VLF EFFECTIVE-CONDUCTIVITY MAP
Robert R. Morgan 15 Jan. 1968 29 p refs
(Contract N00014-67-C-0274)
(Rept.-80133F-1; AD-669916)

A map showing effective electrical conductivity of the earth at very low frequencies (10 kHz to 30 kHz) has been prepared to aid in radio propagation and navigational studies. Values of conductivity were determined for land areas whose boundaries are in most cases based upon climatological, pedological, physiographical, and geological information. Data was collected to aid in establishing regional effective-conductivity values. It was necessary, however, to rely on the correlation between geology and other known environmental factors and conductivity for the majority of the land areas. Author (TAB)

N68-30745 Defence Research Board, Ottawa (Ontario). Telecommunications Establishment.
ALOUETTE 1 IONOSPHERIC DATA ALOSYN
31 Jul. 1964 180 p
CFSTI: $3.00

Alosyn (Alouette topside sounder synoptic) data are tabulated for selected ionospheric parameters obtained from Alouette 1 ionograms based on recordings from 14 telemetry stations in the United States and Australia, Canada, Chile, Ecuador, the Falkland Islands, and Great Britain. The Alouette 1, with an orbital period of 105.4 min, was in an almost circular orbit with an inclination of 90.5 deg. The topside sounder radio frequency changed continuously from 0.5 to 11.5 Mc/s and a complete sweep required approximately 11 sec. Orbital positions, gyrofrequency, and magnetic dip angle were calculated by a NASA computer program. Of the data recorded at the telemetry stations, 1% have time errors greater than 400 sec, and one-fifth of 1% were greater than 10,000 sec. M.W.R.

N68-30759# Naval Oceanographic Office, Washington, D. C.
REMOTE SENSING IN OCEANOGRAPHY
Boyd E. Olson Mar. 1968 41 p
(NOO-IR-68-18; AD-670002)

The paper reviews experience in sensing oceanographic conditions from aircraft and projects plans for extending some of these capabilities for more remote sensing from satellites. Sensing of oceanographic variables from aircraft began with the photographing of waves and ice. Since then remote measurement of sea surface temperatures and wave heights have become routine. Sensors tested for oceanographic applications include multi-band color cameras, radar scatterometers, infrared spectrometers and scanners, passive microwave radiometers, and radar imagers. Remote sensing has found its greatest application in providing rapid coverage of large oceanographic areas for synoptic and analysis and oceanographic prediction. Analyses and predictions are, in turn, used in monitoring sound propagation conditions in the ocean, in routing ships, and in studying conditions controlling the location of fish. Author (TAB)

N68-30772*# Purdue Univ., Lafayette, Ind. Lab. for Agricultural Remote Sensing.
REMOTE MULTISPECTRAL SENSING IN AGRICULTURE
Jul. 1967 75 p refs Prepared in cooperation with Mich. Univ. /its Res. Bull. No. 832
(Grants NGR-15-005-028; NsG-715)
(NASA-CR-95889) CSCL 02D

Use of aerospace platforms and other means for remote multispectral sensing of radiation characteristics of important agricultural features over widespread areas is under investigation in a many-faceted university program, and the processing of data obtained through such sensing is considered. Current and potential test sites are noted, along with the analysis of multispectral imagery and spectroreflectometer data from a preliminary feasibility study. Data collection, reduction, and handling procedures are noted. Effect of moisture contact on feature measurement of the area; correlation between the features; and preliminary classification of corn, wheat, and oats were made from the spectroreflectometer data. Twenty-three color photographs are included to show the areas under investigation. M.W.R.

N68-30843# Westinghouse Electric Corp., Boulder, Colo. Environmental Science and Technology Dept.
PREPARATION OF WORLD WIDE VLF EFFECTIVE CONDUCTIVITY MAP
Robert R. Morgan 15 Mar. 1968 84 p refs
(Contract N00014-67-C-0274)
(Rept.-80133F-2; AD-669917)

A map showing effective electrical earth conductivity values for a propagating wave at VLF (10 kHz to 30 kHz) has been prepared for the major land areas of the world. Land area conductivity determinations were in most cases based upon known geological and climatological information. Actual conductivity data was collected where possible to aid in determining regional effective conductivity values, but the correlation between geology (and other known factors), and conductivity was used in estimating conductivity for the majority of the land areas. The conductivity data are overprinted on seven 17 x 22 inch base maps. Effective conductivity values are designed by numbers from 1 to 10 referenced to a legend on each sheet. Separate page-size maps showing a confidence factor and a variability factor are included in the accompanying report. Author (TAB)

N68-30858# Aeronautical Chart and Information Center, St. Louis, Mo.
GEODESY FOR THE LAYMAN
R. K. Burkard Feb. 1968 99 p refs Revised
(AD-670156)

The use of intermediate and long range rockets and missiles requires that the distance and direction from launch site to target be accurately known. The science of geodesy can help to provide this information. The basic principles of geodesy and geodetic surveying are presented in an elementary form. The formation of geodetic datums is introduced and the necessity of connecting or joining datums is discussed. Methods used to connect independent geodetic systems to a single world reference system are discussed. Particular emphasis is placed on the contribution of the Air Force in developing a World Geodetic System. A chapter on Satellite Geodesy and an appendix on Spherical Harmonics have been added in the present edition. Author (TAB)

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N68-29635# Royal Aircraft Establishment, Farnborough (England).
THE DEVELOPMENT OF A CAMERA FOR THE MEASUREMENT OF AIRCRAFT ENTRY SPEED INTO ARRESTER GEARS
A. J. Smith Nov. 1967 24 p
(RAE-TR-67287) CFSTI: HC $3.00/MF $0.65

Use of requirements for a strip camera as a means of determining aircraft entry speed into arrester gears is discussed. Camera design is considered on the basis of an analysis of system errors. Author

N68-29636# Royal Aircraft Establishment, Farnborough (England).
A TRANSFER STANDARD OF TIME FOR USE OVER GREAT DISTANCES
J. P. Bentick Nov. 1967 19 p
(RAE-TR-67296) CFSTI: HC $3.00/MF $0.65

A clock is described that can transfer standard time over great distances in a vehicle such as an aircraft. The clock would allow the comparison of the standard times used in different countries as well as generate the Omega Navigation System gating waveforms. A feature of the clock is the ease with which adjustments as small as 10 microseconds can be made. A resolution of one microsecond was readily achieved when comparison with other clocks was undertaken. The use of very low frequency radio waves is suggested to implement a time transfer over distances in excess of 10,000 kilometers. It is shown that the accuracy with which the velocity of propagation of these waves can be measured limits the accuracy of the time comparison. Author

N68-29655# Signals Research and Development Establishment, Christchurch (England).
THE DESIGN OF EQUIPMENT FOR MICRO-PHOTOGRAPHY
K. Head Jun. 1967 16 p
(SRDE-67001) CFSTI: HC $3.00/MF $0.65

The design of micro-photographic equipment is given. A number of theoretical considerations are discussed, and the camera construction and lighting unit are described in detail. Author (ESRO)

N68-29668# Whittaker Corp., San Diego, Calif. Narmco Research and Development Div.
FIBERCELL OVERHEAT HAZARD DETECTION SYSTEM Technical Report, Mar. 1967–Feb. 1968
Stanley Yalof Wright-Patterson AFB, Ohio AF Aero Propulsion Lab. May 1968 80 p refs
(Contract F33615-67-C-1613)
(AFAPL-TR-68-44; AD-669382)

The purpose of the program was the development of an airborne overheat hazard detection system, utilizing the proprietary power-generating Fibercell concept as the sensor. Such a sensor must have a detection capability in the primary temperature range from 300F to 1000F, plus the capacity to withstand transient temperatures in excess of these limits. In general, Fibercell consists of a ceramic electrolyte electrochemical cell in the shape of a fiber, which is dependent on its temperature for electrical power output. Since the electrolyte resistivity is logarithmically related to temperature, the cell power output lessens rapidly with decreasing temperature. Below a particular temperature (determined by ceramic electrolyte composition), the cell is effectively disconnected from the alarm system -- a behavior that lends itself to long service life of the cell. During this program, developmental work was directed toward: an improvement of Fibercell performance at the lower end of its operating range; the design of sensors for airborne alarm systems; and the evaluation of sensors under simulated alarm and aircraft conditions to determine their mechanical stamina, as well as their performance as overheat condition sensors. Author (TAB)

N68-29715# Naval Civil Engineering Lab., Port Hueneme, Calif.
LIMIT GAGES FOR MEASURING WIND VELOCITIES Technical Report, Sep. 1966–Dec. 1967
P. J. Rush and R. L. George May 1968 30 p
(NCEL-TR-579; AD-669455)

Field studies assessing the damage caused by hurricane-force winds have revealed a need for simple methods to determine wind velocities causing structural damage. Development of limit wind gage concepts is described. Two concepts, (1) aerodynamic cones in arrays and (2) omnidirectional venturi with recording manometer, provided consistent airstream velocity readings in wind tunnel tests. It is recommended that units of the aerodynamic cone arrays and of the omnidirectional venturi devices be installed for evaluation at several sites where recording anemometers are available and high winds have been experienced. Author (TAB)

N68-29719# Bausch and Lomb, Inc., Rochester, N. Y.
VARISCALE STEREO POINT MARKING INSTRUMENT Technical Report, Jun.–Dec. 1966

Maurits Roos Ft. Belvoir, Va. Army Engr. Topographic Labs. Apr. 1968 27 p
(Contract DA-44-009-AMC-522(X))
(TR-39-TR; AD-669257)

The report covers the engineer tests and evaluation of a stereo point marking instrument, an instrument for analytical triangulation to mark points and transfer these points on photographs with large changes in scale and format size. The instrument has a marking accuracy of better than 2 microns and has a high operating speed; also, it has flexibility with many ease-of-operation features because of the variable parameters of optics, marking dies, and sizes of photographs. Author (TAB)

N68-29721# Naval Ship Research and Development Center, Annapolis, Md. Electrical Lab.
THE APPLICATION OF A COLOR-CORRECTION FACTOR IN THE PHOTOMETRY OF COLORED SIGNAL LIGHTS (A PROPOSED PROCEDURE)
George K. C. Hardesty and T. O. Twist (NBS, Gaithersburg, Md.)
May 1968 39 p refs
(ELECLAB-125/68; AD-669454)

This note presents a proposed procedure for assessing errors and applying corrections in the photometry of colored signal lights and various other luminous visual displays. The procedure is primarily for use with the photomultiplier-telephotometer types of luminance measuring equipments in general use today. It is also suitable for the correction of barrier-layer-cell and other solid-state photoreceptor photometric equipment. The spectral response of the complete photometer (not merely the built-in filter and photomultiplier combination) is first determined. Should the overall response prove to be virtually that of the Commission Internationale de l'Eclairage luminosity function, then no color corrections would be applied. Should the spectral response of the photometer system have significant departures from the Commission Internationale de l'Eclairage curve, then valid corrections require radiometric analysis of the spectral energy distribution of the colored light signal and of the white light source used for standardization of the photometer. Appendix A describes a developmental Spectral Response Evaluator. Author (TAB)

N68-29742# Royal Aircraft Establishment, Farnborough (England).
A RELIABLE GALVANOMETER MOVEMENT FOR USE IN SPACE APPLICATIONS
C. T. Farr Oct. 1967 26 p
(RAE-TR-67260) CFSTI: HC $3.00/MF $0.65

The Report describes the tests performed on a small galvanometer movement, using a pivot–jewel bearing, to assess its suitability for use in space applications. Although only a small number of units was tested, the results suggest that with minor modifications, the mechanism is reliable under a space environment and well suited to certain satellite applications due to its small size, weight, and extremely low power consumption. Author

N68-29747# Aeronautical Chart and Information Center, St. Louis, Mo. Linguistic Section.
GRAVIMETRY: REPORT ON SCIENTIFIC ACTIVITY IN GEODESY AND GRAVIMETRY IN 1963–1966
Feb. 1968 9 p refs Transl. into ENGLISH from the Publ. "Gravimetriya" Moscow, Aca. of Sci., Sect. 4 p 61–70
(ACIC-TC-1359; AD-669228)

The development, manufacture and investigation, both under laboratory and field conditions, have been completed for an automatized vacuum pendulum apparatus necessary for high-precision relative determinations of gravity. The apparatus has thermostatic control; the pressure inside the apparatus is kept close to 1 mm of mercury column. The pendulums are quartz-metal with temperature compensation. The operation of the apparatus is completely automatized and carried out by remote control according to a given program. Periods and amplitudes of pendulum oscillations are recorded by photoelectronic method and are computed from a conversion table. The virtual accuracy of determinations of the gravity increment between two points, performed according to the A-B-A program, is close to plus or minus 0.10 mgal /7, 43, 45/. Author (TAB)

N68-29750# Naval Ordnance Lab., White Oak, Md.
AN ANALYSIS OF TRANSIENT CALORIMETRY
Bruce Hartmann 9 Apr. 1968 31 p refs
(NOLTR-68-35; AD-669446)

The theory and design of a transient calorimeter for convective and radiant heating rate measurements are presented. The major sources of error are pointed out, including: thermal gradients in the slug, heat losses, variable thermal properties, variable heat flux, and surface effects. It is shown that the NOL calorimeter can be depended on for an accuracy of about plus or minus 5%. Experimental measurements in an oxyacetylene burner, arc image furnace, and arc wind tunnel are presented. The measured heat fluxes range from about 20 cal/sq cm sec (74 BTU/sq. ft sec) to 270 cal/sq cm sec (1000 BTU/sq ft sec). In addition to the results for the NOL calorimeter, a general survey of work done by others is presented. Author (TAB)

N68-29808# ARO, Inc., Arnold Air Force Station, Tenn.
DETERMINATION OF TRANSIENT GAS CONSTITUENT CONCENTRATIONS UTILIZING A HIGH ENERGY ELECTRON BEAM Final Report, 1 Nov. 1966–1 Apr. 1967
R. G. Whetsel Arnold AF Sta., Tenn. Arnold Eng. Develop. Center May 1968 65 p refs
(Contract AF 40(600)-1200)
(AEDC-TR-68-88; AD-669564)

In order to determine the available test time in a helium driven shock tunnel, an interface detection system was developed to indicate the arrival of helium driver gas at the test section. This is done by exciting the gas at the test section with a high energy electron beam and spectroscopically analyzing the resulting fluorescence to determine the helium concentration. Relative values of helium and air emission intensities are calculated and compared with experimental data from both static and transient gas mixtures. Author (TAB)

N68-29814# Illinois Univ., Urbana. Electro-Physics Lab.
ELECTRICAL PROPERTIES OF MATERIALS IN THE FAR INFRARED REGION Final Report, 1 Feb. 1966–31 Jan. 1967
Paul D. Coleman and Roberto Roldan 1 Feb. 1968 19 p refs
(Grant AF-AFOSR-272-65)
(AFOSR-68-0465; AD-669573)

A vacuum monochromator for the 80 to 1,000 micron range, under construction for the past year is described. Initial data on the rotational spectra of HCl, HBr, N2O, CH3Cl and CH3CN were taken to test the performance characteristics of the instrument. Performance data indicated that the monochromator characteristics are: (a) Wavelength reproduction 0.1%; (b) Wavelength calibration 0.5%; (c) Relative intensity measurement 5 to 10%; and (d) A resolution of 2% in the 300 to 700 microns range using a carbon bolometer detector and a scan time of 1 hour. Author (TAB)

N68-29816# Westinghouse Electric Corp., Baltimore, Md. Aerospace Div.
HIGH FREQUENCY PARAMAGNETIC RESONANCE Final Scientific Report, 1 Apr. 1965–31 Mar. 1968
D. Mergerian 31 Mar. 1968 16 p refs
(Contract AF 49(638)-1537)
(AFOSR-68-1002; AD-669584)

The report describes a high frequency paramagnetic resonance spectrometer which was designed to operate at frequencies as high as 350 GHz, and its application to a number of specific material investigations. The spectrometer was designed and built during the

initial year of this contract, and was applied initially in the study of CaF2 - Dy(2+). It was subsequently employed in studying the zero field split levels of TiO2 - Mn(3+), ZnWO4 - Ni(2+) and in attempts to observe and measure the zero field splitting of Fe(3+) in the hemoglobin molecule. This latter attempt has so far proven completely unsuccessful indicating that the splitting is considerably greater than 10/cm. Plans have also been formulated to utilize the spectrometer in studies of exchange and anisotropy effects in ferromagnetic, antiferromagnetic and ferrimagnetic materials where high frequency microwave studies may lead to a more complete understanding of these interactions. Author (TAB)

N68-29834*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

CONTAMINATION MONITOR

Robert N. Sheehy Jan. 1968 20 p ref

(NASA-TM-X-63279; X-713-68-134) CFSTI: $3.00 CSCL 06B

A self contained optical–electronic instrument was flown on the AIMP-E satellite to detect contamination deposits on the instrument's sensor surface during launch, transfer trajectory, and insertion into a lunar orbit. Author

N68-29841# European Space Technology Center, Delft (Netherlands).

INVESTIGATION OF THE GENARCO SOLAR RADIATION LAMP (MODEL ME-6-CWM)

G. Saenger Paris ESRO Apr. 1967 128 p refs

(ESRO-TN-4) CFSTI: HC $3.00/MF $0.65

Investigations of the total and spectral intensity distribution of the Genarco lamp ME-6-CWM are reported. A description is given of equipment by which plots with isoflux lines were obtained directly. Author (ESRO)

N68-29889# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

A HIGH-SENSITIVITY NEUTRON AND γ-RADIATION RADIOMETER OF THE VRNG-2 TYPE

L. S. Druskina, V. I. Krasnenkov, and T. V. Timofeyeva 27 Oct. 1967 11 p refs Transl. into ENGLISH from An. Latssr. Inst. Fiz. Radiats. Fiz. (USSR), v. 2, 1964 p 79–86

(FTD-HT-23-856-67; AD-669316)

A universal radiometer for fast, intermediate, and slow n and gamma-radiation is described; it can measure fast-n fluxes in the range 0.03 - 3000 n/sq cm sec. and gamma-radiation in the range of 0.05 - 800 micro-r/sec with relatively high accuracy. The n detector is a ZnS(Ag) scintillator with H3BO3 added (85% 10B). It can be equipped with an organic glass moderator (in the case of fast n) and Cd shield. Gamma-radiation is detected by using a standard gamma-counter. Author (TAB)

N68-29936 Pennsylvania Univ., Philadelphia.

RESONATORS AND GAS SELECTION FOR USE IN TOTALLY RESONANT GAS SYSTEMS AT MILLIMETER WAVELENGTHS

George William Bechtold (Ph.D. Thesis) 1967 135 p

Available from Univ. Microfilms: HC $6.40/MF $3.00 Order No. 67-12726

This dissertation develops interaction structures and gas systems for use in a totally resonant gas system where both the driving field and the harmonic output are resonant with the transition frequencies. This method of pumping drastically reduces the amount of pump power required and results, therefore, in much higher power conversion efficiency than the partly-resonant case. It is concluded that harmonic generation by means of a totally resonant gas system is feasible. This technique is most useful at the shorter millimeter and submillimeter wavelengths where other sources are scarce. Dissert. Abstr.

N68-29947# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CHARACTERISTICS OF THE DYNAMIC CALIBRATION OF AN INSTRUMENT FOR MEASURING THE INSTANTANEOUS TEMPERATURES OF GAS FLOWS [OSOBENNOSTI DINAMICHESKOI TARIROVKI APPARATURY DLYA IZMERENIYA MGNOVENNYKH TEMPERATUR GAZOVYKH POTOKOV]

D. F. Simbirskiy 24 Aug. 1967 11 p refs Transl. into ENGLISH from Samoletostroyeniye i Tekhn. Vozdushnogo Flota (USSR), no. 2, 1965 p 59–62

(FTD-HT-23-874-67; AD-669271)

There are several methods of overcoming the thermal inertia of thermocouples and resistance thermometers in measuring the rapidly changing temperatures of gas flows. The report describes a measuring d-c amplifier built on semiconductor triodes. This instrument makes it possible to make automatic corrections of the signal which is always distorted due to the inertia of the sensor. A line diagram of the amplifier-corrector is given. The correcting four-pole component, the time constant of which V sub K = RC, is in the first stage of the amplifier-corrector. The next two stages make it possible to record the corrected signal on a loop oscillograph. The condition for the execution of the correction is the relation V sub K = V sub D, where V sub D is the time constant of the sensor. It is concluded that the employment of the correcting device makes possible the elimination of the thermal inertia effect of the sensor within a broad range of temperature variations. A quantitative evaluation of the effectivity of the employment of the device may be performed either on a calibrated device with P-shaped temperature pulses, or by analysis of the frequency characteristics of the measuring channel. Author (TAB)

N68-29951*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

STRIKING CHARACTERISTICS OF THE MAGNETRON IONIZATION GAGE IN HELIUM FROM 1.9×10^{-7} TORR TO 7×10^{-10} TORR

William S. Lessiter Washington Aug. 1968 37 p refs

(NASA-TN-D-4681) CFSTI: HC $3.00/MF $0.65 CSCL 14B

The striking characteristics of the magnetron gage were measured in helium over a pressure range of 1.9×10^{-7} torr (N_2) (25.3 $\mu N/m^2$) to 7×10^{-10} torr (N_2) (93.1 nN/m^2). The measured striking characteristics on the upper branches of the striking characteristics diagram agree with the Townsend discharge theory except that, for a given pressure, the characteristics deviate slightly from the theoretical parabolic prediction. On the lower branches, a significant disagreement with theory was found to exist in the dependence of the minimum striking voltage with pressure. Otherwise, on the lower branches, the measured striking behavior agrees with the theoretical prediction and with measurements at higher pressures. Measured striking-time lags occurred in the magnetron gage at pressures bwlow 5×10^{-8} torr (N_2) (6.65 $\mu N/m^2$). The lags were determined to cause no significant error in the measurements of the striking characteristics. Author

N68-29961*# Dunn Associates, Inc., Silver Spring, Md.

DESIGN STUDY OF A FOURIER SPECTROMETER ELLIPSOIDAL MIRROR REFLECTOMETER SYSTEM Final Report

G. J. Kneissl 10 Jun. 1968 82 p refs

(Contract NAS2-4232)

(NASA-CR-73234) CFSTI: HC $3.00/MF $0.65 CSCL 20F

The problems associated with optimizing a reflectometer system, consisting of a fast scanning Michelson interferometer and an ellipsoidal mirror reflectometer (EMR) are considered. System criteria are stated as the capability of measuring the reflectance of opaque materials at room temperature with an accuracy of 1% full scale, covering the wavelength range from 2 to 40μ m. Comparisons are drawn between averaging by the use of an averaging sphere and by detector scanning, and it is shown that the detector scanning technique is superior at long wavelengths where

the system becomes energy-limited. Design data are given on the Fourier spectrometer–EMR system, and on the optimum combination of components which will yield the highest possible signal to noise ratio over the wavelength. Detectors for use at ambient temperature and cooled detectors were assessed. A pyroelectric detector was proposed for ambient temperature operation, along with a liquid helium cooled zinc-doped germanium detector. Correction techniques for systematic errors are described. M.G.J.

N68-30012# Army Electronics Labs., Fort Monmouth, N. J.
TEMPERATURE DEPENDENCE OF THE CALORIC RADIOMETER AND ITS COMPENSATION
Reinhold M. Marchgraber Jan. 1968 23 p
(ECOM-2933; AD-669593)

Radiometers of the caloric type show a dependence of their calibration, which is partly transient and partly static, upon the temperature of their environment. The static dependence, entering as error in continuous integration of radiant fluxes, is discussed and techniques for eliminating this dependence by proper design and/or compensation are described. Author (TAB)

N68-30050 Technische Hochschule Munchen (West Germany).
APPLICATION POSSIBILITIES OF SUPER WIDE ANGLE PHOTOGRAPHS FOR THE PHOTOGRAMMETRIC PRODUCTION OF MAPS [VERWENDUNGSMOEGLICHKEITEN VON UEBERWEITWINKEL AUFNAHMEN FUER DIE PHOTOGRAMMETRISCHE KARTENHERSTELLUNG]
Juergen Hothmer (Ph.D. Thesis) 1967 24 p refs In GERMAN
CFSTI: $3.00

The resolution of wide angel (WA) and superwide angle (SWA) photography is evaluated taking into account the reduction in contrast due to atmospheric effects. Quantitative data are given for the effects of motion blur. The quality of identically scaled WA and SWA photographs is found to be similar, but when taken from identical heights, the marginal zones of SWA photographs are worse. The effects of refraction, earth curvature, spatial deviations, and film shrinkage on the point accuracy of the photographs are considered. The use of SWA in mountainous areas is studied and is found to be advantageous for morphological representations. The available instruments for use in SWA photography are reviewed. Transl. by K.W.

N68-30054# Southampton Univ. (England). Inst. of Sound and Vibration Research.
THE PHYSICAL CHARACTERISTICS OF HOT WIRE ANEMOMETERS
M. R. Davis and P. O. A. L. Davies Apr. 1968 47 p refs
(TR-2) CFSTI: HC $3.00/MF $0.65

In general terms, the processes governing the performance of hot wire anemometers can be divided into three groups. Firstly, there is an equilibrium of energy flows within the electrically heated wire; secondly, the mechanism by which heat is transferred from the surface of the wire into the surrounding fluid; and thirdly the closed loop feedback characteristics of the amplifier system which supplies the heating current to the wire. In this paper, each of these three divisions is considered in turn, dealing with both steady and unsteady effects, with particular reference to constant resistance anemometers. Emphasis is given to the new results which are presented. These include a detailed numerical analysis of the steady and unsteady thermal equilibrium of the wire, the effects of molecular mean free path and yaw angle on surface heat transfer rates and the introduction of second and higher order effects in the dynamic response of the closed loop feedback system. Author

N68-30082# Arnold Engineering Development Center, Arnold Air Force Station, Tenn.
INVESTIGATION OF THE PERFORMANCE OF A GERDIEN CONDENSER IN LOW DENSITY SUPERSONIC FLOW Final Report, 10 Jul.–19 Sep. 1967
D. K. Smith (ARO, Inc.) Jun. 1968 38 p refs
(Contract AF 40(600)-1200)
(AEDC-TR-68-87; AD-670152)

A series of low density aerodynamic tests was completed to provide information on the performance of a full-scale flight configuration of an ion density measurement probe. The tests were conducted at nominal Mach numbers of 2 and 3 and simulated altitudes from 45 to 84 km at angles of attack from 0 to 15 deg. Experimental mass flow efficiency curves were established for a range of flight conditions, and the feasibility of measuring low ion densities in supersonic flows was investigated. The mass flow efficiency data compare well with calculated values at Mach 3 but agree less favorably at Mach 2. Author (TAB)

N68-30086*# General Dynamics/Fort Worth, Tex. Nuclear Aerospace Research Facility.
A DEVICE FOR MEASURING THE SPATIAL ORIENTATION BETWEEN TWO SEPARATING STAGES OF A SPACE VEHICLE
29 Feb. 1968 111 p ref
(Contract NAS8-11995)
(NASA-CR-61888; FZK-352) CFSTI: HC $3.00/MF $0.65 CSCL 22C

Design, development, and testing of the device are described. The design is based on its use between the S-IVB and S-II stages of Saturn V. The measuring capabilities of the system were determined by testing on a full-scale test rig. The theory and fabrication techniques are discussed to assist in any design changes that may be required if the device is to be used for another vehicle configuration. Author

N68-30127*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
CALIBRATION OF 30° INCLUDED-ANGLE CONE FOR DETERMINING LOCAL FLOW CONDITIONS IN MACH NUMBER RANGE OF 1.51 TO 3.51
Walter A. Vahl and Robert L. Weirich Washington Aug. 1968 41 p refs
(NASA-TN-D-4679) CFSTI: HC $3.00/MF $0.65 CSCL 14B

A 30° included angle cone was calibrated to permit determination of the local Mach number, total pressure, and flow angles from measurements of total pressure at the cone apex and static pressure at four equally spaced orifices on the cone surface. The calibration data were obtained at Mach numbers of 1.51, 2.37, 2.96, and 3.51 over an angle of pitch range of 0° to 20°. The test Reynolds number ranged from 6.56×10^6 to 9.85×10^6 per meter. The test results indicate that the accuracy of Mach number determination varies from approximately ±0.010 to ±0.050 at Mach numbers of 1.51 to 3.51, respectively. The accuracy of the total-pressure measurement varies from approximately ±0.5 percent to ±4.5 percent at Mach numbers of 1.51 to 3.51, respectively. The flow angles may be determined within approximately ±0.25° for angles less than 10° and within approximately ±0.50° for angles greater than 10°. Generally, an iterative procedure is required only for accurate determination of the Mach numbers near or greater than 2.37, with angles of pitch above approximately 10°. Author

N68-30154# Texas Univ., Austin. Atmospheric Sciences Group.
REFINEMENT OF THE SHADOWGRAPH TECHNIQUE FOR CALIBRATION OF AN AIRCRAFT CLOUD LIQUID WATER CONTENT INSTRUMENT SYSTEM
Joe L. Sutherland May 1968 37 p refs
(Grant NSF GA-367)
(Rept.-14)

The calibration of hot wire instrument system capable of inflight measurements of the cloud liquid water content and volume median diameter of cloud droplets is discussed along with the calibration of the instrument by a refined shadowgraph technique

of determining liquid water content. Observations were performed in a subsonic wind tunnel modified by the addition of circular array of spray nozzles which provided the liquid water drops. The liquid water content was determined by (1) relating the average liquid water content to tunnel speed, cross-sectional area of the cloud, and flow rate of water entering the nozzles, and (2) taking shadowgraph photographs of the cloud drops for each of the water flow rates and air pressures. From each shadowgraph the liquid water content and volume median diameter were determined from the drop size distributions. Calibration curves drawn from the galvanometer deflection data and liquid water content data are included. Suggestions for improving the accuracy of the calibration are made, and the problems of adapting the shadowgraph technique to aircraft use are briefly mentioned. B.S.D.

N68-30176# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE TECHNOLOGY OF THERMOPLASTIC RECORDING OF IMAGES [TEKHNIKA TERMOPLASTICHESKOI ZAPISI IZOBRAZHENII]

L. G. Tarasenko 8 May 1967 38 p refs Transl. into ENGLISH from Zh. Nauch. i Prikład. Fot. i Kinematografii (Moscow), v. 10, no. 4, 1965 p 298–312
(FTD-MT-66-75; AD-669420)

Thermoplastic recording has a number of advantages in comparison with such classical methods of recording images as photography, electrophotography and magnetic recording. The most important advantages of thermoplastic recording are high resolving power, recording speed and no developing solvents. The principally new diffractional method of thermoplastic recording and production of color images ensures the possibility of achieving high-quality color transmission thanks to the additive principle of mixing colors. Offered only 8 years ago, thermoplastic recording is already applied in certain regions of technology: for recording and reproducing information, in computer technology, for producing film-copies (the Calvar process), etc. Many foreign firms are investigating the region of thermoplastic recording and the number of patents in this area is already more than two hundred. The application of thermoplastic recording for cosmic investigations is very promising. Along with further improvement of electrical methods of thermoplastic recording, at present the most important region of research and invention is development of optical methods of thermoplastic recording that can compete with photography and electrophotography. Author (TAB)

N68-30220*# Techtran Corp., Glen Burnie, Md.

ANEMOMETER WITH A HIGH-FREQUENCY ELECTRIC DISCHARGE [ANEMOMETR S VYSOKOCHASTOTNYM ELEKTRICHESKIM RAZRYADOM]

R. I. Press and Ye. M. Shandalov Washington NASA Jun. 1968 6 p refs Transl. into ENGLISH from Vestsi Akad. Navuk Belarusk. SSR, Ser. Fiz.-Tekh. Navuk (Minsk), no. 4, 1967 p 103–107
(Contract NASw-1695)
(NASA-TT-F-11748) CFSTI: HC $3.00/MF $0.65 CSCL 14B

This article gives the description of a plasma anemometer which uses a high-frequency ac discharge to measure rapidly varying processes, particularly the rapid velocity pulsations and the block and circuit diagrams of the device are examined, and its superiority over a glow-discharge anemometer is demonstrated. Tests performed with the device showed that in the deflection of the flow toward the discharge axis, there appears in the discharge current a constant component that is proportional to the angle of deflection. This effect, attributed to the deformation of the ion space charge, makes is possible to measure the angular velocity component of the flow. Author

N68-30259*# Techtran Corp., Glen Burnie, Md.

APPARATUS FOR PULSE MEASUREMENTS IN ELECTROCHEMICAL INVESTIGATIONS [USTANOVKA DLYA IMPUL'SNYKH ELEKTROKHIMICHESKIKH IZMERENIY]

V. A. Tysgay and Yu. V. Pleskov Washington NASA Jul. 1968 5 p refs Transl. into ENGLISH from Zh. Fiz. Khim. (Moscow), v. 38, no. 8, 1964 p 2111–2113
(Contract NASw-1695)
(NASA-TT-F-11772) CFSTI: HC $3.00/MF $0.65 CSCL 14B

Described herein is a simple apparatus designed for pulse measurements. The apparatus is constructed of commercial instruments. With this apparatus it is possible to measure the differential capacitance and other components of electrode impedance and to record the charging curves. This apparatus also makes it possible to determine the photo potential and recombination rate at the semiconductor-electrolyte interface. The minimal pulse duration is 1 μsec. Author

N68-30328# Universidad Nacional Autonoma de Mexico, Villa Obregon. Facultad de Ciencias.

PREPARATION OF KI(TI) PHOSPHORS FOR GAMMA-RAY SPECTROMETRY [PREPARACION DE FOSFOROS DE KI(TI) PARA ESPECTROMETRIA DE RADIACION GAMMA]

Eduardo Andrade Ibarra 1967 73 p refs In SPANISH
(NP-17352)

A detailed description is given of the operation of scintillation detectors, and the factors affecting their energy resolution are analyzed. The interaction of electromagnetic radiation with matter is discussed to establish the bases to extend the operation of scintillation detectors for γ spectrometry. The operation of activated inorganic phosphors and their efficiency dependence on the concentration of the activator are discussed. The techniques developed to machine and polish adequately KI(Tl) phosphors are described. The quality control and the techniques used are discussed. The results obtained in the comparison of the spectra of ^{137}Cs taken with the phosphor prepared and with a similar commerical phosphor are reported. NSA

N68-30339# Universidad Nacional Autonoma de Mexico, Villa Obregon. Facultad de Ciencias.

POLYETHYLENE SPHERE NEUTRON DOSIMETER [DOSIMETRO PARA NEUTRONES CON ESFERAS DE POLIETILENO]

Felip Ignacio Jimenez Garcia 1967 59 p refs In SPANISH
(NP-17349)

The basic concepts of the interaction of neutrons with matter and the principles of neutron detectors are summarized. The characteristics of $^{6}LiI(Eu)$ as a neutron detector are discussed. Also, the design and construction of a neutron dosimeter with a $^{6}LiI(Eu)$ crystal as the detector is described. The operational characteristics of the dosimeter were determined, and the results are reported. NSA

N68-30340# Universidad Nacional Autonoma de Mexico, Villa Obregon. Facultad de Ciencias.

COMPARISON OF VARIOUS METHODS FOR MEASURING SMALL THICKNESSES [COMPARACION DE VARIOS METODOS PARA MEDIR ESPESORES PEQUENOS]

Alberto Barragan Vidal 1967 43 p refs In SPANISH
(NP-17365)

Three methods for the determination of thicknesses are described and compared. The three methods are weight difference using a microbalance, X-ray fluorescence, and Rutherford dispersion. The most rapid method is the weight difference method using a microbalance. The X-ray fluorescent method is simple, but it is subject to possible errors in the relative intensities of blanks because of the operational instability of the spectrograph and the small geometry. The Rutherford method is subject to systematic errors. NSA

N68-30346# Clarkson Coll. of Technology, Potsdam, N. Y. Dept. of Physics.

TIME-OF-FLIGHT SPECTROMETER FOR NEUTRONS FROM 10 TO 100 MeV

Richard Madey 24 Oct. 1967 7 p Presented at the 1968 Ann. Meeting of the Am. Phys. Soc., Chicago, 30 Jan. 1968
(Contract AT(30-1)-3914)
(NYO-3914-1; CONF-680102-5) CFSTI: HC$3.00/MF$0.65

The description, operation, and resolution of a neutron time-of-flight spectrometer using scintillation detectors are presented. NSA

N68-30349# Clarkson Coll. of Technology, Potsdam, N. Y. Dept. of Physics.
A SPECTROMETER FOR NEUTRONS FROM 10 TO 100 MeV
Richard Madey 15 Jan. 1968 26 p refs Presented at the Intern. Symp. on Nucl. Electron. and Radioprotect., Toulouse
(Contract AT(30-1)-3914)
(NYO-3914-2; CONF-680302-5) CFSTI: HC$3.00/MF$0.65

A new radiation detector instrument system has been designed to measure the spectra of neutrons in the energy region from about 10 to 100 MeV. The principle of the energetic-neutron spectrometer requires first that the incident neutron lose a small fraction of its energy in a collision with a proton in an hydrogenous scintillator and then that the scattered neutron interacts in another scintillator spaced a suitable distance from the first scintillator. The time interval between the two scintillation pulses provides a measure of the neutron energy. Means for discriminating against background events include an anti-coincidence arrangement for rejecting charged particles and a pulse-shape discrimination scheme for rejecting neutron interactions with carbon nuclei. Gamma rays are rejected by time-of-flight and also by pulse-shape discrimination circuitry. Author (NSA)

N68-30364# Union Carbide Corp., Oak Ridge, Tenn. Nuclear Div. Y-12 Plant.
AUTOMATION OF A LONGITUDINAL-COMPARISON THERMAL CONDUCTIVITY APPARATUS
T. L. Williams and J. L. Pate 7 May 1968 54 p refs
(Contract W-7405-ENG-26)
(Y-1607) CFSTI: HC$3.00/MF$0.65

A digital computer has been used to automate a longitudinal-comparison thermal conductivity apparatus. The computer is used to control temperatures inside the device and to store data for future readout when all specified conditions have been satisfied. The computer reduces the time necessary to acquire data, and it allows use of the apparatus during off shifts when no personnel are present. Author (NSA)

N68-30381# Aeronautical Research Labs., Melbourne (Australia).
AN EXPERIMENTAL EVALUATION OF DIGITAL ALTIMETERS
T. J. Triggs Aug. 1966 40 p
(ARL/HE-21) CFSTI: HC$3.00/MF$0.65

Three advanced displays and an improved three-pointer display were evaluated in a comparative experiment. Six airline pilots were used as subjects in this study. They performed with all four altimeters, with a separate session devoted to each altimeter. Each experimental session was conducted in two parts. Static presentations were first read using subject-controlled exposures in a single-task situation. Reading accuracy and display exposure time were recorded during this section. Then an extra-task situation was used where subject performed a tracking task continuously and was called on to make altimeter readings at random times. Tracking performance was recorded in this section in addition to reading times and accuracy. In this section, half the altimeter presentations were undergoing change during display exposure (dynamic presentations). Author

N68-30383# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
CONTINUOUS-WAVE THREE-COMPONENT SONIC ANEMOMETER Final Report, 15 Apr. 1964–30 Jun. 1967
Herbert L. Fox 15 Mar. 1968 76 p refs
(Contract AF 19(628)-4076)
(BBN-1311; AFCRL-68-0180; AD-670217)

A continuous-wave three-component sonic anemometer is described. A physical description is presented, with several illustrations showing the construction of the anemometer and the manner in which it is mounted. Design specifications are presented, and the operating procedure is described. The theory of operation is discussed from the point of view of establishing performance limits on the anemometer. The overall system is discussed and a detailed description of circuits is presented. Instructions for operating the anemometer are presented. Author (TAB)

N68-30415# White Sands Missile Range, N. Mex. Atmospheric Sciences Lab.
THIN FILM TEMPERATURE SENSOR
Bruce W. Kennedy, Klaus Wiemer (Tex. Univ. at El Paso), Claude Karstendiek (Tex. Univ. at El Paso), Walter Roser (Tex. Univ. at El Paso), Ray Upham (Tex. Univ. at El Paso) et al Mar. 1968 28 p refs Prepared jointly with Tex. Univ. at El Paso, Schellenger Res. Lab.
(ECOM-5188; AD-669747)

Development of a thin film temperature sensor for rocket-borne application is discussed. A description of sensor material, response time, substrate material, and flight instrumentation is presented. Construction techniques are briefly described. Results of three rocket flights are shown and discussed. Author (TAB)

N68-30418# Electro-Optical Systems, Inc., Pasadena, Calif.
CHARGE-CONTROLLED STORAGE DISPLAY PANELS Quarterly Report, 1 Oct. 1967–31 Jan. 1968
D. Paul Foote and Benjamin Kazan May 1968 41 p refs
(Contract DA-28-043-AMC-02482(E))
(QR-6; Rept.-6; ECOM-02482-6; AD-670091)

Four 12-inch-square, 50-line/inch image storage panels were fabricated. Measurements were made on these panels to determine their transfer characteristics at various applied voltages and frequencies. The time dependence of brightness after excitation to several different initial brightness levels was measured on each panel. Impedances and phase angle of the panels were also measured with the panels operated at various applied voltages and frequencies, for both the erased and saturated conditions. The electrical admittance characteristic of another (6-inch-square) panel was measured as a function of brightness level. More measurements were made on 6-inch image panels fabricated earlier in the program. The integrated exposure required to excite a panel was investigated over a range of five orders of magnitude of input level and exposure time. Humidity effects on panels made with three different EL phosphors were also studied. Author (TAB)

N68-30421# Instituto Politechnico Nacional, Mexico City. Escuela Superior de Ingenieria Mecanica y Electrica.
DESIGN AND CONSTRUCTION OF A PORTABLE TRANSISTORIZED SCALER [DISENO Y CONSTRUCCION DE UN ESCALADOR PORTATIL TRANSISTORIZADO]
Miguel Angel de la Pena Sanchez 1968 107 p refs In SPANISH
(NP-17360)

A description is given of the different types of radiation and the most frequently used units. The characteristics of some counter tubes for a wide variety of uses are summarized. A discussion of scintillation counters and a description of photomultiplier tubes for use in such counters is also given. The scalers and special circuits most commonly used for counting chaotic pulses are briefly discussed. The principles of the indicator tube are outlined, and the discharge and ignition of these tubes are discussed in detail. The principles used in the design of the scaler are considered, and the design and characteristics are discussed. An economic evaluation is made of the scaler in comparison with other scale... NSA

N68-30432# European Atomic Energy Community, Ispra (Italy). Reactor Physics Dept.
A HIGH-RESOLUTION MOESSBAUER EFFECT ANALYZER [UN ANALIZZATORE PER EFFETTO MOESSBAUER AD ALTO POTERE RISOLUTIVO]
A. Garroni Brussels May 1968 29 p refs In ITALIAN; ENGLISH summary
(EUR-3923.I) CFSTI: HC $3.00/MF $0.65

The design aspects and operating characteristics of an advanced equipment for Mössbauer effect analysis are described. This equipment is characterized by high velocity resolution (25 μ m/sec) and automatic operation. The achieved performances are typically represented by a velocity error of 10^{-4}. Author

N68-30434# Bhabha Atomic Research Centre, Bombay (India).
OPTIMUM PARAMETERS FOR A CONSTANT DEVIATION MAGNETIC SPECTROGRAPH
M. N. Viswesvariah and N. Sarma 1967 58 p refs
(BARC-320) CFSTI: HC $3.00/MF $0.65

Certain aspects of the ion optics of a constant deviation magnetic spectrograph are presented, and criteria are applied to optimize on source distance, and incident and exit angles. Data are presented graphically and in tabular form. Author

N68-30436# Institut Franco-Allemand de Recherches, St. Louis (France).
CALIBRATION OF SKYLIGHT OPTICAL MEASURING DEVICES [EICHUNG VON LICHTMESSGERAETEN FUER AUFSTIEGE]
F. Roessler and D. Bock 19 Jan. 1967 35 p refs In GERMAN
(T-2/67) CFSTI: HC $3.00/MF $0.65

Described are systematic experiments to improve the calibration precision of rocket or balloon carried devices for optical measurements of the diffuse sky light as a function of increased height. The use of gray filters and a reflective lamp with condensor as additional light source improved the measurement accuracy of the self controlled photomultiplier considerably. All obtained curves were connected to each other by parallel adjustment. Prolongation of the optical bench to 12 cm increased the calibration precision. A brief instrumetal error calculation was included. Transl. by G.G.

N68-30500# Eidgenossische Technische Hochschule, Zurich (Switzerland).
RAPID PULSE-HEIGHT DISCRIMINATOR WITH COMPENSATION FOR ASCENT AND RISE-TIME EFFECT [EIN SCHNELLER IMPULSHOEHENDISKRIMINATOR MIT KOMPENSATION DER ANSTIEGSZEIT UND DES SCHWELLENEFFEKTES]
Hans Jung (Ph.D. Thesis), 1967 57 p refs In GERMAN; ENGLISH summary Its Dissertation No. 3981
CFSTI: HC $3.00/MF $0.65

Variations in the amplitude of pulses give rise to time dispersion in a subsequent pulse-height discriminator. A pulse-height discriminator is described which electronically effects a compensation for the time dispersion. It is designed for pulses which have a common rise-time T_R between 0.5 and 5 ns. The discriminator threshold can be set to any desired height from 1.6 V to over 5 V. The threshold width is below 50 mV. For pulses with T_R = 5 ns, the maximum time dispersion lies below ± 50 ps for amplitude variations between 0 and 15 V and frequency variations between 0 and 100 kHz. The discriminator was designed for a fast neutron time-of-flight spectrometer, with a view to reducing the line broadening caused by the continuous pulse-height spectrum of the neutron detector. The spectrometer, based upon the associated-particle technique, is briefly described. The full width at half height of the coincident neutron spectrum is smaller than 0.7 ns for a scintillator thickness d = 1 cm, and is virtually independent of the threshold energy. Even at but a few percent of the peak height, the line width remains relatively small, which permits quite weak effects to be recognized in the vicinity of strong lines in the time-of-flight spectra. Author

N68-30503# Institute Franco-Allemand de Recherches, St. Louis (France).
STUDY OF A HIGH SPEED CLOSING DEVICE FOR A LARGE APERTURE [ENTWICKLUNG EINES KURZZEITVERSCHLUSSES GROSSER OEFFNUNG]
G. Weihrauch 8 May 1967 15 p refs In GERMAN
(T-35/67) CFSTI: HC $3.00/MF $0.65

Described is the construction of a high speed photographic shutter that has a 70 mm aperture and an effective closure time of ≤ 20 μs. High velocity dust or vapor clouds, triggered by explosives or spark jumps, are injected into the optical ray path for closure instead of electromechanical shutters. Industrial ignition pellets eject clouds of soot at 1000 to 1500 m/s into the round photo cell where they clog the window by forming an opaque layer. Transl. by G.G.

N68-30553 Japan Broadcasting Corp., Tokyo. Technical Research Labs.
VIDEO SIGNAL PROCESSING AND ANALYSIS FOR NEGATIVE COLOR FILM TRANSMISSION
Soichi Iwamura Mar. 1968 31 p refs *Its* No. 12

Consideration is given to the electronic inversion into positive color of negative color film in which a negative color film is picked up by a color film camera used with three vidicons, and the image so obtained is reversed by the video signal processing and is reproduced as a positive image on the color picture tube. The operational advantages and problems in the inversion transmission of negative color film are mentioned. In comparision with other film transmission systems, it is shown that this system of inversion transmission has excellent operational characteristics for rapid processing and broadcasting of color films, especially color news reels. The structure of color film layers with the subtractive mixture process is explained. The inversion transmission system corresponding to this is described in detail. The characteristics of negative color films are investigated, and measured values are compared with their rated values. The pickup characteristics of color television camera equipment and their corresponding video signal processing system are shown. Author

N68-30574# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
FIXED ANGLE SCATTERING (FAS) METHOD FOR X-RAY CRYSTAL STRUCTURE ANALYSIS
B. Buras, J. Chwaszczewska, S. Szarras, and Z. Szmid 1968 17 p refs
(Rept.-894/II/PS) CFSTI: HC $3.00/MF $0.65

A new method for X-ray crystal structure analysis is proposed. In this method a polychromatic X-ray beam is scattered on a powder sample and the energy distribution of the X-rays scattered under a fixed angle is measured by means of a semiconductor detector connected to a multichannel pulse-height analyser. The peaks are indexed in the usual way by means of the Bragg equation. The formula of the integrated intensity applicable to this method is given. A very preliminary experimental check of the feasibility of the method is described, a number of improvements discussed, and several applications of the method mentioned. Author

N68-30616# Aeronautical Research Council (Gt. Brit.).
A SHORT STATIC PROBE WITH GOOD INCIDENCE CHARACTERISTICS AT SUPERSONIC SPEED
I. S. Donaldson and D. J. Richardson 23 Oct. 1967 17 p refs
(ARC-29558; AD-670302)

Tests carried out on a short static probe at supersonic speeds between Mach numbers of 1.1 and 2.5 are described. The

probe consists of a 50 deg included angle cone-cylinder having sensing holes 0.88 calibres aft of the cone-cylinder junction. The tests show that at zero incidence the probe measures a pressure (approximately independent of Mach number) of 0.793 times the local static pressure. They also show that, at up to 18 deg incidence in any pitch plane, the pressure measured is 0.763 plus or minus 0.03 times the local static pressure. For a limited Mach number range near a Mach number of 1.6, this accuracy can be maintained to incidences over 30 deg. Of particular interest is the fact that relatively small internal differences between externally identical probes appear to have a significant effect on the incidence characteristics and in some respects can improve the performance. Author (TAB)

N68-30625*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
RESEARCH ACHIEVEMENTS REVIEW, VOLUME 11
1968 45 p *refs*
(NASA-TM-X-53743; Rept.-12) CFSTI: HC $3.00/MF $0.65
CSCL 14B

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N68-30626*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
HYDROGEN SLUSH DENSITY INSTRUMENTATION
Alvin M. Payne *In its* Res. Achievements Rev., Vol. 11 1968 p 3–9 refs (See N68-30625 18-14)

As slush hydrogen will increase the cryogenic storage capabilities of hydrogen-fueled space vehicles, efforts were undertaken to develop an accurate slush density reference system and to modify two transfer standards for making reliable field measurements of the mass of slush hydrogen after calibration with the reference system. The reference consists of a cryostat nearly full of triple-point liquid hydrogen and a lightweight container completely submerged in the liquid hydrogen while hanging on a weighing system on top of the cryostat. Archimedes' principle is applied to determine the density. Equations are derived for computing the volume of the container based on the difference in the weight of the hydrogen filled container and the empty container. An error analysis method is also described. Also discussed are the modifications made to the nuclear radiation attenuation transfer standard which is mounted outside the dewar, and the internal point densitometer which is located inside the slush container and is supported from the cover, which serves as a lid when in the raised position. When lowered for weighing, the cover and attachments to the container are not weighed. M.G.J.

N68-30627*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
PRESSURE TRANSDUCERS FOR ENVIRONMENTAL EXTREMES
Harlan S. Harman *In its* Res. Achievements Rev., Vol. 11 1968 p 11–17 refs (See N68-30625 18-14)

Two research programs are reviewed. One discusses design development and fabrication of an experimental high temperature, high frequency response pressure transducer for combustion instability studies requiring frequency response of 20 kHz in an environment where temperature reaches 4144°K (7000°F) and the heat flux can be as high as 8200 W/cm^2 (50 Btu/in.^{2}-sec). The second covers the design, development and fabrication of a cryogenic pressure transducer for static and dynamic measurements at liquid helium temperatures of 4°K. Author

N68-30628*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
THE USE OF THE MOSSBAUER EFFECT AND LASER INTERFEROMETRY TO DETERMINE EXTREMELY SMALL AMPLITUDES FOR VIBRATION MEASUREMENTS AND CALIBRATION
Helmut G. Lackner *In its* Res. Achievements Rev., Vol. 11 1968 p 19–31 (See N68-30625 18-14)

One method makes use of the Mossbauer effect (recoil-free emission and absorption of gamma rays): the extremely sharp resonance lines are dissolved by Doppler shift and can be used for measuring velocities of a fraction of a millimeter per second. Since the peak of a Mossbauer line or the peaks of its hyperfine structure are fundamental constants expressed in velocity, a simple calibration technique for electromechanical oscillators has been developed where the instantaneous velocity of the oscillating object is compared with a Mossbauer line. The other method makes use of refined laser interferometry where monochromaticity, coherence and intensity of laser light are used to produce a stable photocurrent in which the ratio of its frequency components depends on the vibration amplitude. Both methods will allow reaching minimum amplitudes of a few angstrom units with an estimated uncertainty of 2%. Author

N68-30630# Aktiebolaget Atomenergi, Stockholm (Sweden).
AN ON-LINE WATER MONITOR FOR LOW LEVEL
E. J. M. Quirk May 1968 26 p refs
(AE-319) CFSTI: HC $3.00/MF $0.65

A detection system is described for the continuous monitoring of β-radioactivity in the secondary cooling water at the Studsvik R2 reactor. Radiation emanating from a water surface is measured by a large area gas proportional detector. To protect the detector from splash caused by bursting bubbles a protective film and heater assembly is interposed between the detector and the water surface. A special feature is the programmed "exercise" sequence for the magnetic valves which eliminates a tendency for them to stick after prolonged periods of idleness. The extent to which contamination affects the background counting rate has been studied. It is shown that for the duration of the tests described the monitor remains free from the effects of contamination so long as the scaler live time is suitably chosen. Author

N68-30650# Instituto Politechnico Nacional, Mexico City. Escuela Superior de Ingenieria Mecanica y Electrica.
DESIGN AND CONSTRUCTION OF A RATE METER [DISENO Y CONSTRUCCION DE UN MEDIDOR DEL NUMERO DE DESINTEGRACIONES POR UNIDAD DE TIEMPO]
Jorge Eduardo Fernandez Parriego 1967 109 p refs in SPANISH
(NP-17356)

A transistorized rate meter that can be used either with a-c current or with accumulators or a battery was designed and developed. The methods for the detection and determination of the characteristics of radiation are outlined. The principles of the operation of the rate meter are described. The operational characteristics of the rate meter were determined and are reported. NSA

N68-30651# Aktiebolaget Atomenergi, Stockholm (Sweden).
SPECIAL CRYOSTATS FOR LITHIUM COMPENSATED GERMANIUM DETECTORS
A. Lauber, B. Malmsten, and B. Rosencrantz May 1968 17 p refs
(AE-320)
CFSTI: HC $3.00/MF $0.65

In many applications of Ge(Li) detectors an extreme design of the cryostat is desirable. One example is a coincidence or anticoincidence steup where the Ge(Li) detector is surrounded by one or several other detectors, usually NaI(Tl) crystals of plastic scintillators. In this arrangement the part of the cryostat containing the Ge(Li) detector should have the form of a long hood, with the detector placed at its very end. The diameter of the hood should be as small as detector dimensions permit. Excellent energy resolution and reasonably low liquid nitrogen consumption must be retained. Two cryostats fulfilling these conditions are described. For the first cryostat emphasis lay on the reduction of the hood diameter to an absolute minimum; for the other incorporation of a device regulating the temperature of the cryostat surface was required. The difficulties encountered were primarily connected with the necessity of combining minimum temperature loss at the detector position with extreme cryostat compactness and cold finger length. Author

N68-30668# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
METHODS OF FABRICATION FOR GERMANIUM AND SILICON DETECTORS WITH COMPENSATION BY LITHIUM-ION DRIFTING [METHODES DE FABRICATION DE DETECTEURS AU GERMANIUM ET AU SILICIUM COMPENSES PAR MIGRATION D IONS DE LITHIUM]
Bernard Bornand Mar. 1968 74 p refs In FRENCH
(CEA-BIB-90)

A bibliography on the fabrication of germanium and silicon detectors with compensation by lithium-ion drifting is presented. Mounting, packaging, encapsulation, and methods of control for preparation are included, as also resolution and efficiency measurements and spectrometry when the fabrication is concerned. A list of abstracts with references to reviews, reports, thesis, proceedings, and patents (168 references) from 1964 to 1967 (1st semester) with some references at earlier dates (e.g. patents) is given. There are included: subject index, periodical, report and patent number index, and personal author index. In a supplement, 12 abstracts of communications for the 11th Scintillation and Semiconductor Counter Symposium (Washington, Feb. 28–March 1, 1968) are presented. Author (NSA)

N68-30679# Army Engineer Geodesy, Intelligence and Mapping Research and Development Agency, Fort Belvoir, Va.
A COMPARATIVE STUDY OF PHOTOGRAPHY FOR SOILS AND TERRAIN DATA Technical Report, 1–30 Sep. 1968
Olin W. Mintzer Apr. 1968 53 p
(Rept.-38-TR; AD-670012)

A comparative study was made of ground-controlled aerial photography over the Phoenix, Arizona, test area for soils determination. Three separate emulsions were studied: Plus-X (panchromatic) film; Ektachrome-MS (color) film; and Ektachrome (color) Infrared film. Author (TAB)

N68-30749# Stanford Univ., Calif. Linear Accelerator Center.
THE HUMMINGBIRD FILM DIGITIZER SYSTEM
J. Van Der Lans, J. L. Pellegrin, and H. J. Slettenhaar Mar. 1968 57 p refs
(Contract AT(04-3)-515)
(SLAC-82) CFSTI: HC $3.00/MF $0.65

The Hummingbird automatic film digitizer for analyzing particle tracks on bubble and spark chamber film is described. Also, precision cathode ray tube deflection systems for graphical data processing are discussed. Tube geometry and deflection distortions, deflection amplifiers, focus corrections, spot size and pulse detection, and filtering and track center circuits are considered. NSA

N68-30786# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
ENDOTHERMIC PROCESSES IN TISSUE-EQUIVALENT PLASTIC
D. M. Fleming and W. A. Glass 4 Apr. 1968 10 p ref Presented at the 16th Ann. Radiation Res. Soc. Meeting, Houston, Tex.
(Contract AT(45-1)-1830)
(BNWL-SA-1760; CONF-680421-1) CFSTI: HC $3.00/MF $0.65

An experimental evaluation of the thermal defects due to endothermic chemical reactions encountered in using tissue-equivalent plastic in absorbed dose calorimeters is presented. Absolute calorimetric measurements were made using Shonka-type tissue-equivalent plastic irradiated with monoenergetic protons. NSA

N68-30819# Dayton Univ., Ohio.
A DIAMETER GAGE FOR TRUE STRESS-TRUE STRAIN MEASUREMENTS OF TENSILE SPECIMENS AT REDUCED TEMPERATURES
Ira B. Fiscus and James M. Carson (AF Mater. Lab.) Wright-Patterson AFB, Ohio AF Mater. Lab. Feb. 1968 30 p refs
(Contract F33615-67-C-1087)
(UDRI-TR-68-04; AFML-TR-68-27; AD-669848)

The true stress-strain relationship in specimens undergoing tensile tests is being computed from a continuous record of the axial load and of two perpendicular profile traces of the specimen cross section. The displacement of two sets of opposing fingers, in contact with and constantly traversing the specimen, produces a strain-gage output on an oscillographic record. This record is proportional to the specimen profile. The tensile tests may be conducted at a variety of low temperatures using two cryostats. The first is capable of operation at a number of specific temperatures as low as 77K and will accommodate either round or flat specimens. The second cryostat is capable of operating at temperatures from 4K to 77K with the round specimens only. Author (TAB)

N68-30820# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
THE ELECTRONIC DESIGN OF THE DODGE CAMERA HEADS
R. C. Beal Feb. 1968 84 p refs
(Contract NOw-62-0604)
(TG-963; AD-669996)

Approximately 22 months after the conceptual design of the DODGE cameras the first color pictures of the full disk of the earth were transmitted to earth. In some ways the evolution of the design of the cameras is as interesting as the photographs they produced. It is the authors purpose, not only to document the final design, but also to lend the reader some insight into the motivation for making certain design decisions. In an effort to attain this goal, alternatives that were not implemented for one reason or another are discussed as well as possibilities for future improvements. Author (TAB)

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N68-29600# Royal Aircraft Establishment, Farnborough (England).
THE USE OF NUMERICALLY CONTROLLED MACHINE TOOLS IN R.A.E. WORKSHOPS
S. W. Potter Dec. 1966 43 p refs
(RAE-TR-66408) CFSTI: HC $3.00/MF $0.65

Introduction and use of Numerically-Controlled Machine Tools in the Workshops Department of R.A.E. up to December 1966 is discussed, with examples covering two-dimensional position control, two-dimensional continuous control, and three-dimensional contoured shapes with initial use being concentrated on manufacture and measurement of aerodynamic models and their associated equipment for wind tunnel testing. Advantages from this form of control led to the use of numerically controlled machines for more orthodox engineering manufacture. These advantages, which outweigh the disadvantages, make it inevitable that numerical control will progressively replace to a larger extent the manually operated machines. Numerical control will permit reduction in the amount of inspection of components. Author

N68-29602 Wisconsin Univ., Madison.
A QUANTITATIVE ANALYSIS OF THE DEVELOPMENT OF CARBIDE TOOL CRATER WEAR
Raymond Neville Meyer (Ph.D. Thesis) 1967 358 p
Available from Univ. Microfilms: HC $16.20/MF $4.60 Order No. 67-6816

Flank wear has long been used as the common measure of tool life; but only a relatively few investigations have been made on crater wear. The investigation of the crater wear of carbide tooling becomes a timely study because of the general trend toward modern economical machining practice which requires increased cutting speeds and feeds. The objective of this thesis is to investigate in detail the development of carbide tool crater wear as a function of cutting speed, feed and tool radius. Modern statistical techniques are used to quantitatively evaluate the crater wear response. A new optical crater wear measuring technique, employing an objective lens with a narrow depth of field to allow the direct photography of the depth contour was developed. A comprehensive collection of crater wear data revealing the basic crater development of 35 cutting conditions was obtained through the use of the optical contour mapping technique. Dissert. Abstr.

N68-29752# ARO, Inc., Arnold Air Froce Station, Tenn.
DESIGN AND DEVELOPMENT OF A SERVOCONTROLLED GAS INBLEED SYSTEM FOR A HIGH VACUUM CALIBRATION CHAMBER Final Report, 1 Mar.–1 Sep. 1967
Albert J. Mathews and Fred M. Shofner Arnold Eng. Develop. Center May 1968 41 p refs
(Contract AF 49(600)-1200)
(AEDC-TR-68-100; AD-669562)

A servocontrolled gas inbleed system for a dynamic, calibrated conductance type of vacuum calibration system was designed and fabricated. The servocontrolled gas inbleed system automatically regulates the flow of gas into the test region of the calibration system by maintaining a constant pressure on the upstream side of a molecular leak. Constant pressure on the molecular leak is established and maintained by a shunt control technique in which a gas inlet valve and a gas pumpout valve are operated in parallel. An analog computer was used to aid in the design of the system. The transient and steady-state response of the servocontrolled gas inbleed system is predicted by the computer. Good agreement was obtained between the analog computer data and the experimental performance data obtained from the gas inbleed system. The gas inbleed system can control the flow rate in the range from 0.00001 torr-liters/sec to 0.001 torr-liters/sec. Other flow rates are obtainable by changing system components; however, the same design procedure is applicable. Author (TAB)

N68-29832 Dartmouth College, Hanover, N. H.
IMPROVED MANUFACTURE OF POLYURETHANE FOAMS
Andrew Porteous (D.Eng. Thesis) 1967 163 p
Available from Univ. Microfilms: HC $7.60/MF $3.00 Order No. 67-12500

A significant improvement in flexible polyurethane foam manufacture has been made. It is shown that foam making in a reduced ambient pressure atmosphere can save the U.S. foam industry 2.8×10^6 annually due to the elimination of volatile chemical blowing. Several additional potential areas for development have also been investigated. It is recommended that some of the more promising of these should be investigated further for special applications. Dissert. Abstr.

N68-29903*# Westinghouse Electric Corp., Baltimore, Md. Aerospace Div.
FABRICATION OF THERMAL COATED EXTENDABLE BOOM Final Report
20 Mar. 1968 42 p refs
(Contract NAS5-10130)
(NASA-CR-95805; Rept.-7826A) CFSTI: HC $3.00/MF $0.65 CSCL 11F

A process for coating booms to be thermally stable was developed for use in the Application Technology Satellite. An α ratio of about 6:1 between internal and external absorptivities, and minimization of total heat were required. The coatings used are vacuum-deposited aluminum for the outside surface and black copper oxide on the inside surface of a beryllium copper alloy strip. Details are given on the problem areas encountered and techniques developed for the initial cleaning of the raw beryllium copper strip, application of a masking lacquer, development of the black copper oxide on the strip, removal of masking lacquer, photo masking and etching, metallizing the strip with aluminum, and boom forming. Solar absorptance and reflectance of the coated strip are measured in order to evaluate space stability of the boom. Also, evidence is presented to show the desired property of low evaporative loss of copper oxide in a space vacuum environment. D.H.B.

N68-29918*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
INFLUENCE OF SURFACE ACTIVE AGENTS ON FRICTION, DEFORMATION, AND FRACTURE OF LITHIUM FLUORIDE
Donald H. Buckley Washington Aug. 1964 29 p refs
(NASA-TN-D-4716) CFSTI: HC $3.00/MF $0.65 CSCL 11H

Sliding friction experiments were conducted with lithium fluoride crystals in various environments. These included air, water, hexadecane without and with various organic acids, and a paraffinic oil containing oleic acid. Sliding was on the (001) plane in the [100] direction at a speed of 0.005 millimeter per second and under loads of 5 to 200 grams on a millimeter-diameter sapphire rider which contacted the lithium fluoride flat. The results indicate that the presence of surfactants influences deformation and fracture in lithium fluoride. Crystals deform plastically more readily with an adsorbed organic acid than without it; this is the Rehbinder effect. Friction coefficient was influenced by the presence of the acid, its chain length, and its concentration. Author

N68-29970# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PRODUCTION OF GAS TURBINE MOTORS (CHAPTERS 4 AND 5)
A. M. Abramov, I. L. Zelikov, M. F. Idzon, and A. B. Konarev 6 Jun. 1967 146 p refs Transl. into ENGLISH from the book "Proizvodstvo Gazoturbinnykh Dvigateley" Moscow, Izd. Mashinostr., 1966 p 151–282
(FTD-MT-67-18; AD-669303)

The report is a 1966 publication of two chapters of the book on machine building. Chapter IV, entitled Manufacture of Parts by Cold Stamping includes sections on all phases of this technique. Chapter V, entitled Manufacture of Parts by Welding is similarly organized regarding the welding process. Basic methods are mentioned and directions given for suitable application of each type of operation, mainly in tabular outline. Author (TAB)

N68-30017# Army Mobility Equipment Command, Fort Belvoir, Va. Research and Development Center.
GPM-350, OPTIMUM LIGHTWEIGHT FILTER/SEPARATOR, DECEMBER 1965–OCTOBER 1966
George A. Gariepy and Edward C. Russell Apr. 1968 42 p
(USAMERDC-1927; AD-669613)

This report covers design, development, engineering design test, and evaluation of a 350-gpm, optimum, lightweight filter/separator for primary application with the military Fuel System Supply Point and the 4-Inch Liquid Fuels Hoseline System. These units were subjected to the comprehensive evaluations necessary to determine conformance to the water- and solids-removal performance requirements of MIL Spec MIL-F-8901A. In addition, rail-impact and rough-handling tests were conducted. Author (TAB)

N68-30161# Oak Ridge National Lab., Tenn.
ESTIMATING THE RELIABILITY OF SYSTEMS
A. P. Fraas May 1968 32 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-2200) CFSTI: HC $3.00/MF $0.65

Generic data on component reliability are reviewed, a simple method of applying these data is suggested, and some resulting implications with respect to the reliability of idealized systems are pointed out. Data for a number of familiar systems such as refrigerators, automobile engines, and TV sets are examined using the same technique and found to yield results consistent with those given by the simplified application of the generic data. The study concludes that there is an enormous amount of operating experience to indicate that the lowest failure rate one can reasonably hope to get in a piece of mechanical equipment such as a valve, pump, or motor is about one failure per million operating hours. From this it is shown that, if a system is to be designed for a 90% probability of operating 10,000 hr without a forced outage, it ought not require more than about ten thoroughly proven mechanical components (such as pumps) or one hundred thoroughly proven electronic components (such as resistors). Author (NSA)

N68-30401# Technische Hochschule Munchen (West Germany).
ANALYSIS AND SYNTHESIS OF FIVE-CHANNELED AND FIVE-JOINTED SPACE CRANK DRIVES [ZUR ANALYSE UND SYNTHESE FUNFGLIEDRIGER, FUNFGELENKIGER RAUMKURBELGETRIEBE]
Reinhold Elsen (Ph.D. Thesis) 1968 121 p refs In GERMAN
CFSTI: HC $3.00/MF $0.65

Euler angles and the dynamic model of a general five-element five-jointed forced spatial crank drive, consisting of three swival joints, one ball pivot, and one slip joint, are used to analyze the motion sequence of a ball bearing during output revolution. Combined geometric and matrix methods are utilized to familiarize the construction engineer with the complicated work cycle of the five-element spatial crank drive. Also investigated are recycle behavior, extreme and forked positions, as well as the effects of construction changes in the gear unit. Transl. by G.G.

N68-30446# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ACCELERATED TESTS FOR RELIABILITY AND DURABILITY OF MACHINE BUILDING INDUSTRY PRODUCTS [USKORENNYE ISPYTANIYA NA NADEZHNOST I DOLGOVECHNOST IZDELII MASHINOSTROENIYA]
K. P. Chudakov and A. I. Kuberev 17 Aug. 1967 12 p Transl. into ENGLISH from Standartizatsiya (Moscow), no. 9, 1965 p 33–36
(FTD-HT-67-22; AD-670095)

Different methods for accelerated life and reliability testing are discussed qualitatively. Since it is not practical to wait 3 to 4 years to determine the reliability and wear characteristics of a given machine, accelerated tests must be performed which will give sufficient data in 3 to 6 weeks to predict the long-term behavior of machine elements. This can be achieved by either increasing the number of cycles per unit time, by intensifying the loads, or by both methods. It has been shown repeatedly that wear processes and fatigue processes can be extrapolated from limited test data with an accuracy of plus or minus 10%. Although under industrial conditions the scatter may be as much as plus or minus 150%, these extrapolation techniques give an excellent indication of average wear, life, and reliability. When fatigue is the life-limiting factor, the fatigue limit can be established by several increasing-load methods, such as a constant load increase to destruction, stepwise load increase to destruction, or cyclically increasing loads. Each of these methods has advantages for certain applications. Determining the fatigue limit by the critical stress method is of particular interest. This method depends on the energy hypothesis of fatigue, by which it has been established that the cyclic constant and the critical number of cycles are constant for a given type of metal. No specific recommendations are made, and the article represents a very general, qualitative discussion. Author (TAB)

N68-30455# Union Carbide Corp., Oak Ridge, Tenn. Nuclear Div. Y-12 Plant.
RESISTANCE SPOT WELDING STAINLESS STEEL FOIL BY THE EXPENDABLE-WIRE TECHNIQUE
C. L. Estes 19 Apr. 1968 17 p
(Contract W-7405-ENG-26)
(Y-1613) CFSTI: HC $3.00/MF $0.65

A spot welding method, which consists of placing an expendable copper wire between the workpiece and the electrode of the resistance spot welder, was developed, demonstrated, and evaluated. This technique eliminates the need for electrode dressing, produces elongated spot welds that reduce the number of individual welds needed, and can be used at locations that are very close to the edges of the workpiece. Author (NSA)

N68-30461 Laboratorio de Acustica e Sonica, Sao Paulo (Brazil).
ULTRASONIC SELECTION AND INSPECTION OF CAST ALUMINUM BLOCKS [VERIFICACAO E SELECAO DE BLOCOS DE ALUMINIO FUNDIDO POR PROCESSO ULTRA-SONICO]
C. Mendonca Filho and H. Onusic 4 Mar. 1968 11 p In PORTUGUESE; ENGLISH summary
(Rept.-11)

The report describes the equipment used, method and procedure adopted for the ultrasonic inspection and selection of cast aluminum blocks. The inspection was originated by the presence of defects on the end extruded tubes and the reason was to verify if there are cast defects or not, in order to correct the casting process or the extrusion process. The results are presented in schematic drawing form, with indication of the defects position, accompanied by photographs of the observed echograms. Author

N68-30488# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE EFFECT OF SURFACE ACTIVE MEDIA ON MACHINING
Min-chic Liu and Kui-chin Wang 21 Aug. 1967 9 p refs Transl. into ENGLISH from Chin Shu Hsueh Pao (Peking), v. 8, no. 2, 1965 p 274–276
(FTD-HT-67-90; AD-670097)

The purpose of this study was to attempt to find some active lubricating cooling fluid (coolants) which are suitable for use in production work. This paper explains by actual tests the reason why active surface media are able to weaken the strength of materials. Author (TAB)

N68-30508# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PULSE MAGNETIC STAMPING [IMPULSNAYA MAGNITNAYA SHTAMPOVKA]
P. Ya. Pyt'yev 15 Sep. 1967 32 p Transl. into ENGLISH of the book "Progressivnye Tekhnologicheskie Protsessy i Ikh Mekhanizatsiya. Sbornik Statey" Kuybyshev, 1964 p 71–103
(FTD-MT-24-144-67; AD-670071)

This article investigates pulse methods of treating materials by means of high energies. The author commences by stating the advantages and describing the development of pulse magnetic stamping. Formulas are derived for both electroinductive pulse magnetic stamping and electrodynamic magnetic stamping which describe the theoretical bases of these methods. The practical applications of electroinductive pressing are discussed vis-a-vis tubular and hollow billets, plane parts, hole punching, and molding parts from ingot slabs. The design of cylindrical stationary inductors, cylindrical breaking inductors, and plane inductors for stamping parts from hollow and plane billets is then investigated. Following this, the author shows the practical application of electrodynamic magnetic stamping of tubular billets. The article concludes with a brief investigation of the power and mechanical equipment for pulse magnetic stamping. Author (TAB)

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N68-30536# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ROLLING OF METALS AND BIMETALS IN VACUUM [PROKATKA METALLOV I BIMETALLOV V VAKUUME]
A. V. Krupin and N. V. Yudina 8 Sep. 1967 38 p refs Transl. into ENGLISH from the book "Prokatnoye i Volochil'noye Proizvodstvo, 1965. Itogi Nauki i Tekhniki, Seriya: Metallurgiya" Moscow, 1966 p 131–168
(FTD-MT-24-197-67; AD-670074)

Investigations show that during deformation in vacuum and in inert gases the intensity of interaction of metals with active gases essentially drops. This ensures obtaining pure and ultra-pure metals and parts (intermediate products) from them. Plasticity is increased and in a number of cases strength of metals, surface quality is improved, losses decrease and yield of suitable metal is increased. The possibility is created of hot working by pressure metals which cannot be deformed in air without special safety measures, due to their great reactivity or toxicity. Deformation in vacuum and in inert media ensures obtaining bimetals with increased and special properties, which cannot be obtained during pressure treatment in air. Treatment by pressure (rolling, forging, pressing and others) in vacuum and in inert media is a very effective and promising method for the production of parts and semifinished products from pure and ultra-pure refractory and rare metals and alloys on their bases without contamination by harmful impurities, and also obtaining bimetals of different compositions with special properties. Author (TAB)

N68-30769# Hawker Siddeley Aviation, Ltd., London (England).
PRE-PRESSURE JIG WELDING OF A LARGE STAINLESS STEEL AIRCRAFT FUEL TANK
Mar. 1968 33 p
(Contract KS/1/0417/CB/43(a)2)
(S&T-MEMO-9/67; AD-669874)

The report describes the pre-pressure resistance spotwelding technique which was developed to spotweld internal former to the skin of a saddle shaped fuel tank. The component parts to be welded are clamped together over the entire joint area in a welding fixture to ensure an intimate fit at the interface joint. The clamping bars holding the joint have a dual purpose in that the bar on one side has location holes to position the welding electrode (held in the portable gun) while the other bar which is made of copper provides the (electrode) backing bar that the spotweld is made upon. The portable resistance welding gun is of the expander type and the electrode force is developed by the action of the gun against a reaction member attached to the electrode location clamping bar. The contact face of the reaction member is made of copper from which the welding current is picked up by the gun and transferred to the component joint. location holes are also provided to ensure the alignment of the gun normal to the surface of the component. A detailed description of the design of the welding fixture incorporating the secondary resistance welding circuit is given in the report with the results of welding tests carried out. Author (TAB)

N68-30773# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INFLUENCE OF THICKNESS OF LUBRICANT LAYER ON LONGEVITY OF ANTIFRICTION BEARINGS [VLIYANIYE TOLSHCHINY SMAZOCHNOGO SLOYA NA DOLGOVECHNOST' PODSHIPNIKOV KACHENIYA]
D. N. Parakhonskiy 3 Oct. 1967 10 p refs Transl. into ENGLISH from Tr. Aviats. Inst. (Kuybyshev), no. 15, 1963 p 345–351
(FTD-MT-24-198-67; AD-670295)

The longevity of a contact point between two moving bodies is estimated as a function of the lubricant thickness in the contact zone. From experimental studies the contact load is related to the number of load cycles and a longevity ratio is obtained. The result is plotted graphically. The results are the same for roller as well as ball bearings. TAB

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N68-29624# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Gas Ionizzati.
SUITABLE TARGETS FOR AN EXPERIMENT OF PLASMA PRODUCTION BY A LASER BEAM IN A VACUUM ENVIRONMENT
A. Cecchini, A. de Angelis, and R. Gratton Mar. 1968 13 p refs Sponsored in part by EURATOM
(LGI-68-8) CFSTI: HC $3.00/MF $0.65

An experimental device for production and injection of small deuterium specks in a vacuum region is described. The linear dimensions of the specks are of the order of 10^{-2} cm. The reproducibility of the injection direction is fairly good and insures the possibility of ionizing the specks by a conveniently synchronized focused giant laser pulse. Author (ESRO)

N68-29789 Utah Univ., Salt Lake City.
MEASUREMENT OF ATMOSPHERIC AEROSOLS BY POLARIZED-LASER LIGHT SCATTERING
Roger William Call (Ph.D. Thesis) 1967 142 p
Available from Univ. Microfilms: HC $6.80/MF $3.00 Order No. 67-12358

A new method of taking aerosol measurements using scattered light from a laser beam fired into the atmosphere is developed and tested. The method developed uses measurements of light scattered from a polarized laser beam to find the aerosol attenuation coefficient, the aerosol number density and the aerosol size distribution. The method was tested by making measurements from a secondary site distant from the laser transmitter. Results are plotted for attenuation coefficients up to 30 kilometers in altitude. The

Rayleigh theory of light scattering by small particles is reviewed for the case of a polarized incident light beam. The Mie theory of light scattering by spherical particles is applied to aerosol scattering, and Mie scattering functions specifically for use with polarized light beams are computed for various aerosol size distributions. Theory is developed for making two-station backscatter measurements using a pulsed ruby laser as a light source. The Rayleigh and Mie scattering functions are applied to the geometry of the problem, and by considering the polarized properties of the laser beam a simplified scattering equation is developed. Dissert. Abstr.

N68-29851 Stanford Univ., Calif.
INFRARED MODULATOR UTILIZING FIELD INDUCED FREE CARRIER ABSORPTION
Dan Williams Peters (Ph.D. Thesis) 1967 80 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-11059

Recent developments in coherent lasers in the infrared region make communication systems in the region feasible. An integral component of such a system is the modulator. This research describes an infrared modulator that utilizes field-induced free carrier absorption. The intensity of a light beam can be varied by a voltage controlled absorption process within the modulator. The basic absorption process is free carrier absorption. A modulation voltage is appropriately applied to a semiconductor crystal within the modulator inducing carriers (holes or electrons) on the surface of the crystal. The light beam is reflected internally from the semiconductor surface where a fraction of the energy in the beam is absorbed by the surface space charge. The density of the space charge on the semiconductor surface is controlled by the applied voltage, which permits the amount of absorption to be varied. Modulation frequency was limited to values less than 100 kHz because of detector limitations. Dissert. Abstr.

N68-30013# Army Electronics Labs., Fort Monmouth, N. J.
BROADBAND LASER DISPLAY SYSTEM Progress Report, Jan.–Dec. 1967
S. Leroy Everett, Jr. Jan. 1968 80 p refs
(ECOM-2937; PR-1; AD-669607)

This is the first progress report of a series describing the in-house design, fabrication, and evaluation of a Broadband Laser Beam Digital Deflector Display System. The model will be a flexible breadboard assembly which will be used to evaluate and demonstrate broadband or multi-color, laser beam deflection and display techniques. The output of the deflector will be 1024 discrete output light beam positions in each of two dimensions totaling over one million discrete locations. The color and the discrete position of the output beam will be controlled by conventional digital logic circuits. A primary advantage of this multi-color display system is the precise position registration of the small diameter, less than 50 micron, output light beam. General system design guidelines based upon previous external contractual study are presented. Use and extrapolation of these guidelines to determine optical crystal specifications for use in the breadboard deflector are described. A preliminary mechanical model of a split-angle deflector and a two-stage total internal reflection deflector have been designed and fabricated during this reporting period. Laboratory test and evaluation of the electro-conductive substrates for the electro-optic switch assembly are presented. Test procedures, results, and evaluation of small aperature electro-optic modulators for color beam selection are included. Author (TAB)

N68-30047*# North Carolina State Coll., Raleigh.
EFFECTS OF GEOMETRIC DEVIATIONS AND NONLINEARITIES IN COHERENT OPTICAL DATA PROCESSORS Progress Report
Frederick J. Tischer 30 Jun. 1968 172 p refs
(Grant NGR-34-002-038/S1)
(NASA-CR-95803) CFSTI: HC $3.00/MF $0.65 CSCL 20E

The study deals with signal distortions in optical data processors, particularly optical correlators, caused by departures of signal-carrying surfaces from specified geometry and by nonlinearities incurred in signal recording. Methods are developed for describing the error effects. An equivalent noise-to-signal ratio is introduced for describing the severity of the signal distortions. This method allows a numerical evaluation of the various effects and facilitates optimization of data processing and holographic reproduction systems. The method for analyzing nonlinearities is based on Chebyshev expansions of nonlinear characteristics. Chebyshev polynomials were found to be particularly well suited to this problem. Numerical methods and a digital computer program for determining the Chebyshev coefficients were developed. The computer program is applied to an analysis of the characteristic curves of type 649-F spectroscopic plates. K.W.

N68-30085# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
RAMAN EFFECT OF MULTIPLE RADIATION PROCESS AND ITS APPLICATIONS IN SPECTROSCOPY
Yin-yuan Li 25 Aug. 1967 23 p refs Transl. into ENGLISH from Wu Li Hsueh Pao (Peking), v. 20, no. 2, 1964 p 164–172
(FTD-HT-66-496; AD-669428)

It may become possible to observe the third-order process of radiation in the strong electromagnetic field of a laser beam with two photons absorbed and a third one emitted during a transition between energy levels of a material system. This process is analogous to the ordinary Raman effect, in which only two photons are involved. A theoretical analysis is given and the conclusion reached that with a beam intensity of 0.1 MW/sq cm, the vibrational Raman spectrum of molecules or crystals may be obtained by the three-photon process. It is shown that this effect actually offers a new spectroscopic method. Its importance lies in the difference of the selection rule of this effect and that of the infrared absorption and the ordinary Raman effect. It is also pointed out that the stimulated radiation of three-photon Raman effect may be realized when pumped with a powerful laser beam. Author (TAB)

N68-30106# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
LIGHT-DETECTOR AND WEAPON
V. Krasnov 13 Nov. 1967 92 p refs Transl. into ENGLISH of the book "Svet–Lokator, Svet–Oruzhiye" Moscow, Izd. Dosaaf, 1964 p 1–103
(FTD-HT-23-609-67; AD-669305)

A beam of light from a quantum generator is a million times brighter than the sun at the same solid angle. Having a high concentration of energy, the beam of a quantum generator can easily pierce a thick metal plate, even a diamond. Focused into a needle beam, the weapon becomes a deadly weapon. Using the beams of a quantum generator, direct communication with the planets and the stars can be achieved. Successful experiments with light-communications have been conducted on Earth. Quantum generators can be used also as optical locators. In range and accuracy they are far better than radar. In 1962 optical detection of the Moon was made. It became possible to examine in detail the lunar surface and, in the future, other planets of the solar system. The tremendous density of the energy of the new beams permit their wide use in various technologies. Author (TAB)

N68-30174# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE POSSIBILITY OF THE APPLICATION OF GAS LASERS IN THE HIGH-PRECISION MEASUREMENT OF DISTANCES [O VOZMOZHNOSTI PRIMENENIYA GAZOVYKH LAZEROV PRI VYSOKOTOCHNOM IZMERENII RASSTOYANII]

V. V. Golosov, D. V. Gordeyev, Ye. P. Ostapchenko, V. A. Perebyankin, and V. F. Khomaza 22 Sep. 1967 13 p Transl. into ENGLISH from Geodez. i Kartograf. (Moscow), no. 5, 1966 p 9–15
(FTD-MT-24-201-67; AD-670113)

Experiments are described in which the light source of precision optical range finder (SG-2M) was replaced by a small gas laser. The purpose of the experiment was to increase the accuracy of distance measurements with such a range finder and to permit its use under daylight conditions. Another advantage of the laser is that it delivers a beam of much narrower spectral width. The gas was a mixture of helium and neon operating at 6328 A and delivering not less than 1 mW. The measurements were made of distances of the order of 3 km in sunlight and during twilight. In daylight, when the ordinary light source could not be used, the mean square measurement accuracy was plus or minus 2.4 mm, and in twilight, plus or minus 1.3 mm. Equipping the range finder with a laser approximately doubled the maximum distance measurable at night. The requirements that must be satisfied by the laser are specified, and it is found that the IG-55 developed by one of the MEP SSSR enterprises is the most suitable for this purpose. The specifications of this laser are listed. Author (TAB)

N68-30212* Aztec School of Languages, Inc., Acton, Mass. Research Translation Div.
TRANSFORMATION OF A LASER EMISSION DURING FORCED RAMAN SCATTERING
V. A. Alekseyev and I. I. Sobel'man Washington NASA Jul. 1968 15 p refs Transl. into ENGLISH from Russian Presented at the Quantum Electron. Conf., Miami, Fla., 14–17 May 1968
(Contract NASw-1692)
(NASA-TT-F-11816) CFSTI: $3.00 CSCL 20E

A description is given of forced Raman scattering in transverse and longitudinal pumping for first and second Stokes components and a means is given for finding all subsequent Stokes components based on the expressions derived. Author

N68-30248*# Gulf General Atomic, San Diego, Calif.
RADIATION EFFECTS ON LASERS Final Report, 1 Jul. 1966–Oct. 1967
D. M. J. Compton 1 Nov. 1967 80 p refs
(Contract NAS12-32)
(NASA-CR-86068; GA-8238) CFSTI: HC $3.00/MF $0.65 CSCL 20E

A continued program designed to study the effects of space radiation on lasers and to develop the background knowledge needed for the possible application of laser systems in a space environment; is reported. The effects of radiation are described for two main types of laser: Gallium arsenide laser diodes, and optically pumped lasers, such as ruby and neodymium in various host materials. Results indicate that: (1) neither type of laser is affected by doses and dose rates of space radiation suitable for manned space flight; (2) for more severe environments, e.g., flights spending a large fraction of their time in the trapped radiation belts or with reasonably shielded on-board nuclear power, it is possible to select laser types which will be only minimally affected and whose performance can be restored by an annealing process; and (3) for very severe environments, e.g., near on-board nuclear power, it is at least possible to set certain guidelines relating to the effects to be expected. S.C.W.

N68-30322# Naval Radiological Defense Lab., San Francisco, Calif.
INSTRUMENTATION FOR TIME-RESOLVED MASS SPECTROMETRY APPLICATION TO LASER-VAPORIZATION OF SOLID MATERIALS
Kenneth A. Lincoln Mar. 1968 24 p refs
(USNRDL-TR-68-36; AD-669453)

A technique has been developed for coupling a pulsed laser with a time-of-flight mass spectrometer so that low vapor pressure materials, such as, polymers and refractories, can be vaporized directly in the ion source of the spectrometer. Concomitantly, the instrumentation for recording time-resolved mass spectra has been improved to permit more quantitative measurements of short-lived species, and is applicable to any mass spectral analysis of transient events in the submillisecond (or longer) time domain. Two types of time resolution are possible; the first gives the duration of all the mass peaks (within a designated range), and the second can present the intensity of any six preselected mass peaks as a function of time for each laser pulse. Performance of the laser-mass spectrometer system has demonstrated its ability to conveniently vaporize such refractory materials as graphite and readily discriminate between the transient vapors like C3 and the stable ones, such as, C2H2. Moreover, laser heating has manifested a very practical advantage in the elimination of background spectra due to heated sample containers and support structures. Author (TAB)

N68-30330# Stichting voor Fundamenteel Onderzoek der Materie, Jutphaas (Netherlands). Instituut voor Plasma-Fysica.
PLASMA PRODUCTION AND HEATING BY LASER RADIATION
F. P. Kuepper Feb. 1968 28 p refs Sponsored by EURATOM
(NP-17453; Rept.-68-44)

A review of the present status of the theories and experiments of the production and heating of plasmas by laser radiation is given. This includes the problem of plasma confinement by external magnetic fields and by the laser radiation field itself. On the basis of the calculated models the possibility of the production of a thermonuclear plasma by laser radiation is discussed. It is concluded that with the present-day laser technology a thermonuclear plasma with a fusion energy release greater than the laser radiation energy may be produced on a time scale of nanoseconds. Author (NSA)

N68-30344# Radioptics, Inc., Plainview, N. Y.
THE INVESTIGATION OF THE USE OF NUCLEAR RADIATION IN THE PREPARATION OF OPTICAL MASER MATERIALS Final Report
Henry Sadowski, Kalman Held, and James Beckerley 14 Aug. 1967 106 p ref
(Contract AT(30-1)-3330)
(NYO-3330-18)

Exposure of ruby lasers and a variety of neodymium-doped glass lasers to cobalt-60 gamma-ray doses of a few tens of megarads followed by optical bleaching and thermal annealing cycles (up to two hours at 400°C) has been found to increase the slope efficiency of some of the lasers. The effect is reproducible and constitutes an upgrading of the lasers for pumping energy inputs above certain minimum levels. Processed lasers are stable at room temperature. Experimental results are summarized and the commercial prospects for use of the process are discussed. It is noted that in addition to upgrading lasers, the process may be valuable as a means for controlling the quality of lasers, that is, controlled upgrading of a group of lasers to a predetermined level of performance. Author (NSA)

N68-30498# Institut Franco-Allemand de Recherches, St. Louis (France).
HOLOGRAPHY OF A MOVING PHASE OBJECT AT VERY HIGH SPEEDS [HOLOGRAPHIE D'UN OBJECT DE PHASE ANIME D'UNE VITESSE ULTRA-RAPIDE]
P. Smigielski 19 Dec. 1967 14 p refs In FRENCH
(T-41/67) CFSTI: HC $3.00/MF $0.65

A tranverse of axial swinging ruby laser is used to obtain holographs of shock waves caused by either hypervelocity projectiles or spark jumps in air. Described are the most important characteristics of these studies. Transl. by G.G.

N68-30509# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
GENERATION LOSSES OF A SOLID-STATE OPTICAL QUANTUM GENERATOR [O POTERYAKH OKG NA TVERDOM TELE V PROTSESSE GENERATSII]
V. I. Lebedev and V. A. Pilipovich 27 Jul. 1967 10 p refs Transl. into ENGLISH from Dokl. Akad. Nauk Belorussk. SSR (Minsk), v. 10, no. 9, 1966 p 644–646
(FTD-HT-23-579-67; AD-670058)

Resonator losses during different stages of generation were measured experimentally in terms of variation in the beam divergence and spot diameter at the rod end of a ruby laser. The test laser consisted of a polished cylindrical ruby rod 120 mm long and 12 mm in diameter. The laser cavity was formed by two external dielectric mirrors (each 99% reflective) placed 46 mm apart. The rod was pumped by two IPKKh 130/14 straight pulsed xenon lamps placed inside a polished cylindrical Duralimin reflector 36 mm long. The lamp input was 2900 j and the pulse threshold energy 900 j. Changes in beam divergence and beam spot diameter were recorded on film by means of a high-speed camera. Experimental data indicate that cavity losses increased with the pumping energy. Author (TAB)

N68-30548# Michigan State Univ., East Lansing. Dept. of Chemistry.
REDESIGN AND CONSTRUCTION OF A LASER RAMAN SPECTROPHOTOMETER
R. E. Miller, K. L. Treuil, R. R. Getty, and G. E. Leroi May 1968 65 p refs
(Contract N00014-68-A-0109-0003)
(TR-4(29); AD-669797)

A summary is given of the considerations which were involved in the design and construction of a laser Raman spectrophotometer. Based on previous experience with the design and performance of the instrument located at Princeton University (see AD-651 646), certain improvements were incorporated. The present system consists of commercial He-Ne and argon-ion laser excitation sources emitting more than 80 mw and 4 watts total output, respectively, a double monochromator, a cooled photomultiplier, dielectrically coated optics, and electronics for dc amplification and pulse counting. Some representative Raman spectra are shown to illustrate the performance of this instrument, and for comparison purposes between the previous and current designs. Author (TAB)

N68-30652# Raytheon Co., Waltham, Mass. Research Div.
INVESTIGATION OF MODE-LOCKING AND CERTAIN OTHER MECHANISMS IN LASERS AND THEIR IMPLICATIONS Final Report, Jan.–Dec. 1967
H. Statz, G. A. de Mars, and M. Bass Jun. 1968 95 p refs
(Contract F19628-67-C-0252)
(S-1055; AFCRL-68-0234; AD-670199)

In the report we investigate the basic mechanisms that lead to mode locking in lasers and to the formation of ultrashort pulses. We find that in lasers nonlinear polarizations are produced at the so-called combination tone frequencies which act much like externally injected signals. When the amplitudes of the combination tone polarizations are large enough, the various modes may lock onto them and definite phase relationships between these modes are established. The amplitudes of the source polarization terms are proportional to the third power of the electric field and thus locking depends upon the power level of the laser. Furthermore, the nonlinear polarization is proportional to the fourth power of the dipole matrix element between the two states in question and thus depends strongly on the radiative lifetime of the upper laser state. It is thus clear why a short lifetime saturable absorber is very effective in producing self locking. It can also be shown that a mode-locked laser emits more radiation than an oscillator with random phases. Also investigates mode suppression in ring lasers and related devices. It is found that for sufficiently large splittings of a given longitudinal mode, one of the split-off components tends to become suppressed. This is due to the fact that the gain in one of the modes is significantly lower. Mode suppression of this type is investigated in Nd(3+) - doped YAG lasers. Author (TAB)

N68-30799# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
OPTICAL SECOND HARMONIC GENERATION IN REFLECTION FROM MEDIA WITH INVERSION SYMMETRY
N. Bloembergen, R. K. Chang, S. S. Jha, and C. H. Lee May 1968 44 p refs
(Contract N00014-67-A-0298-0006)
(TR-563; AD-670005)

The radiation at the boundary of an isotropic or cubic medium by a polarization at 2w=omega, which is proportional to the product of the incident laser field at omega and a spatial derivative of this field, is examined theoretically. A complete expression for the intensity and polarization of the reflected harmonic radiation as a function of the angle of incidence and state of polarization of the incident laser beam is derived. The angular dependences are in good agreement with observations on Si, Ge and Ag. Some additional experimental results, not previously reported, are described. The magnitude of the nonlinearity due to bound electrons in these cubic materials is related to the square of the linear susceptibility, and agrees qualitatively with observations in Si, Ge and alkali halides. This nonlinearity has the same order of magnitude as that caused by conduction electrons in metals, which has been extensively discussed in the literature. The influence of adsorbed surface layers is considered. Author (TAB)

N68-30852# ITT Avionics, Nutley, N. J.
LASER TELEMETER FOR ARTILLERY PIECE
L. M. Vallese and Milner W. Wallace Feb. 1968 46 p ref
(Contract DA-28-017-AMC-3455(A))
(AD-669627)

The work of design and fabrication of three Laser Telemeter units for artillery piece, having seven channels of IRIG telemetry and using a PPM GaAs laser, is described. In addition, the design of a PPM-to-PDM converter unit to be used in connection with detection and recording of the telemetry information is described. Author (TAB)

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 08 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N68-29579 Utah Univ., Salt Lake City.
ANNEALING SPECTRUM OF ELECTRON-IRRADIATED NIOBIUM AND TANTALUM
Ehab Mohamed Abd El-Salam 1967 98 p
Available from Univ. Microfilms: HC $5.00/MF $3.00 Order No. 67-10300

Whereas the annealing behavior of radiation damaged face-centered cubic metals is becoming progressively better understood as a result of an abundant amount of both theoretical and experimental data published during recent years, the corresponding situation is much less clear for other types of metals. The aim of this thesis is to describe an investigation of the annealing of defects in niobium and tantalum induced by electron-irradiation using 1.95 Mev electron beam. The specimens were irradiated at 13.2°K and subsequently annealed at temperatures up to 301°K.

Isothermal-isochronal annealing procedures were used. A brief sketch of the mathematical analysis for computation of the activation energies (in both liquid helium and liquid nitrogen temperature ranges) is given. Detailed comparisons are made between the damage production data, annealing spectrum for both metals and for those for noble metals. Dissert. Abstr.

N68-29592# General Electric Co., Philadelphia, Pa. Missile and Space Div.
INVESTIGATION OF BONDING IN OXIDE-FIBER (WHISKER) REINFORCED METALS Final Progress Report, 18 Apr. 1967–18 Apr. 1968
W. H. Sutton and M. J. Noone 18 May 1968 53 p refs
(Contract DA-19-066-AMC-0330(X))
(AMMRC-CR-66-01/7; AD-669654)

In a continued study of the effects of wetting, bonding and interfacial reactions in the system Ni-alloy/Al2O3 (sapphire), the emphasis was placed on the influence of interfacial reactions on the strength of the underlying sapphire. This aspect is of prime importance in the development of high-strength reinforced composites with nickel matrices. High-strength flame-polished sapphire rods were prepared and used to assess quantitatively the effects of surface interactions with Ni-alloys on the strength of sapphire. Severe surface degradation was observed and resulted in relatively low measured strength; similar effects were also observed qualitatively on sapphire whiskers. The need for a protective coating to preserve the surface (and hence the strength) of sapphire filaments was thus indicated. Some studies of possible barrier coatings for use in this application were initiated. Preliminary work was conducted on W, HfC and TiC coatings. Author (TAB)

N68-29594# Boeing Co., Renton, Wash. Commerical Airplane Div.
MICRO VOIDS INFLUENCE METAL PROPERTIES
D. Webster 23 Jan. 1968 24 p refs
(D6-19772; AD-669212)

Voids were found to form around hard particles during the deformation of both thoria dispersed nichrome (TDNiC) and a martensitic stainless steel, AFC 77. In the TDNiC the voids retard recrystallization and thereby increase high temperature strength. In AFC 77 the voids prevent austenite grain growth. Author (TAB)

N68-29603 Wisconsin Univ., Madison.
THE INFLUENCE OF HYDROGEN ON THE SURFACE AND INTERFACIAL TENSIONS OF CERTAIN TRANSITION ELEMENTS
Thomas Allan Roth (Ph.D. Thesis) 1967 178 p
Available from Univ. Microfilms: HC $8.20/MF $3.00 Order No. 67-6825

Values were determined for the surface and interfacial tensions of pure iron, cobalt, and nickel in the solid state and the influence hydrogen has upon these properties was studied. A modified zero-creep technique was combined with measurements of the dihedral angles formed at the intersections of grain boundaries with the surfaces in fine wires to determine absolute values of the surface and interfacial tensions of the three pure metals. Fine wires, 0.005 inch in diameter, were heated in gaseous atmospheres of pure helium, pure hydrogen, and a mixture of equal amounts of helium and hydrogen at temperatures 75 to 150°F below the melting points of the metals. The balance load for zero-creep for each of the gaseous atmospheres was determined from plots of load versus elongation for a series of wires for each metal. Dissert. Abstr.

N68-29608# Junta de Energia Nuclear, Madrid (Spain). Direccion de Quimica e Isotopos.
SPECTROGRAPHIC DETERMINATION OF IMPURITIES IN URANIUM TETRAFLUORIDE [DETERMINACION ESPECTROGRAFICA DE IMPUREZAS EN TETRAFLUORURO DE URANIO]
C. Capdevila, M. Roca Adell, and F. Alvarez Apr. 1967 18 p refs In SPANISH; ENGLISH summary
(JEN-192-DQ/I-66) CFSTI: HC $3.00/MF $0.65

A carrier distillation method for the determination of Ag, Al, As, B, Cd, Cr, Cu, Fe, Mg, Mn, Ni, Pb and Si in uranium tetrafluoride was developed. The previous addition of 25% Y_2O_3 prevents the excitation of uranium by conversion of the volatile UF_4 into U_3O_8 during the arc discharge. NaCl or Ga_2O_3, containing Ge and V as internal standards, are used as carriers, and samples are arced in 10 Amp. d.c. arc in a graphite anode cup, 7 mm diameter, 10 mm deep, being the weight of charge 300 mg. Sensitivities are in the range 0.1–20 ppm, and the precision attained lies between ±9.0 and ±16.4%. For Ca and P samples are mixed with SiO_2 and coverted into the black oxide by heating at 400°C. Author (ESRO)

N68-29610# Illinois Univ., Urbana. Theoretical and Applied Mechanics Dept.
ENVIRONMENTAL CRACKING IN AISI 4340 STEEL Final Report
W. A. Van der Sluys Feb. 1968 Feb. 1968 20 p refs
(Grant DA-ARO(D)-31-124-G872)
(T&AM-312; AROD-5612.3-MC; AD-669255)

Knowledge of the subcritical flaw growth characteristics of the material under the expected service conditions is an important part of any fracture control plan. The prime causes of subcritical flaw growth are fatigue, adverse environment, or both. Fatigue loading will cause crack growth in all metals while adverse environments may or may not. In some steels a moist air environment is of severe enough nature to cause substantial subcritical flaw growth. For the materials engineer working in the area of fracture control, all flaw growth due to environment has become known as stress corrosion cracking although the mechanism in many cases is probably not one of corrosion. Therefore, in this paper the term environmental cracking will be used when referrng to cracking caused by adverse environments. Author (TAB)

N68-29620 Florida Univ., Gainesville.
THERMAL EXPANSION IN DILUTE SOLID SOLUTIONS
Kamala Sivasubramaniam (Ph.D. Thesis) 1966 222 p
Available from Univ. Microfilms: HC $10.15/MF $3.00 Order No. 67-12932

Dilute alloys of transition metals in normal metals and in other transition metals often exhibit at low temperature anomalous behavior of many of their physical properties such as electrical resistivity, thermal conductivity, and specific heat. The present study is concerned with thermal expansion of dilute solid solutions in iron. This work evolved from a report of non-monotonic thermal expansion of iron alloys containing less than one atomic percent of chromium, molybdenum, and tungsten. Dilute iron alloys have also been found to show disproportionately large changes in recrystallization behavior which seems correlated with the free-atom electron configuration of the solute. The behavior of the iron-manganese alloys is not understood. The present results, together with the large negative thermal expansions observed in concentrated iron-manganese and iron-nickel face-centered cubic alloys, indicate that the electronic/magnetic Gruneisen parameter may be strongly dependent on alloy concentrations and that the crystal structure and the magnetic properties of the solute play an important role in determining the behavior of these alloys. Dissert. Abstr.

N68-29625 Utah Univ., Salt Lake City.
GRAIN GROWTH IN HIGH PURITY AND DILUTE ALLOYS OF MAGNESIUM
Theron Glenn Odekirk (Ph.D. Thesis) 1967 166 p
Available from Univ. Microfilms: HC $7.80/MF $3.00 Order No. 67-12298

An investigation into the normal grain growth of high purity magnesium and its dilute alloys of 0.01, 0.02 and 0.039 atomic percent zinc and of 0.011, 0.016 and 0.031 atomic percent

manganese was conducted. The mechanism for normal grain growth of high purity magnesium was determined to be a single event process of self diffusion across the grain boundary with an activation energy of 18.3 kcal/g atom and an activation entropy less than the entropy of fusion. The grain growth process was found to follow the absolute reaction rate theory and the normal grain growth law of $D^2 = K t$. The rate of grain growth of high purity magnesium was reduced by a factor of 100 for the alloys. The induction time for observable grain growth was found to be directly related to the process of primary recrystallization. Electron transmission photographs show evidence that very little internal strain remains in the recrystallized grains thus supporting a driving force of grain boundary free energy. Dissert. Abstr.

N68-29658# Illinois Univ., Urbana. Mining, Metallurgy and Petroleum Engineering Dept.

TRANSFORMATION PLASTICITY OF COBALT-NICKEL SINGLE CRYSTALS

Emmanuel de Lamotte and Carl Altstetter 15 Apr. 1968 58 p refs

(Contract DA-31-124-ARO(D)-297)

(AROD-4953.2-MC; AD-669629)

The influence of an external stress on the allotropic transformation of single crystals of a Cobalt-30.5% Nickel alloy was investigated. Experimental results were obtained from dilatometry, x-ray diffraction, and optical and electron microscopy. The effects of stresses could be conveniently divided into three stress ranges. In range I, from 0 to about 400 g/sq mm, the specimens exhibited on cooling a multivariant phase change and a considerable amount of retained cubic material. In range II, from 400 g/sq mm to the elastic limit, the product phase had a simpler morphology. Single hexagonal regions grew in size and the cubic phase disappeared with increasing stress level. In range III, just above the elastic limit, specimens transformed into hexagonal single crystals. Specimens prestressed in range III and transformed in range I also became hexagonal single crystals. The observed macroscopic shear directions were mainly 112 on cooling but the behavior was more complicated on heating under stress. To explain these properties of the phase change, a model based on the nucleation of partial dislocations is proposed. Author (TAB)

N68-29661# Reactor Centrum Nederland, Petten.

SULFIDE, INTERGRANULAR, STRESS CORROSION CRACKING OF K-MONEL STUDS THAT FAILED DURING SERVICE IN HIGH TEMPERATURE, HIGH PRESSURE AUTOCLAVES AND IN PRESSURIZED WATER PUMPS

A. van der Linde Nov. 1967 35 p refs

(REN-91) CFSTI: HC $3.00/MF $0.65

Consideration is given to K-Monel studs which failed by intergranular cracking after about 1000 hours service in autoclaves, operating at 300°–400°C and 100–180 atmospheres with pure water, and after about 350 hours service in a pressurized, 340°C and 175 atmosphers, water pump. The investigations, and failure reproduction experiments performed with used and not used studs showed that sulfur, formed by decomposition of the fatty ingredient in Molykote G paste lubricant, was the attacking agent. At the roots of the stressed threads, the K-Monel surface was confronted with an increasing amount of sulfur and hydrogen-sulfide during service. Moreover grain growth and copper diffusion to the grain boundaries, possibly in combination with bulk material sulfur diffusion to the grain boundaries, increased the material susceptibility for stress corrosion attack during service. In order to avoid this type of failures the available sulfur content in the nickel alloy surface environment as well as the sulfur content in the nickel alloy itself must be kept as low as possible. Author (ESRO)

N68-29748# Army Materials Research Agency, Watertown, Mass.

PROPERTIES AND APPLICATIONS OF DISPERSION STRENGTHENED METALS

Stanley M. Wolf Jun. 1967 23 p refs

(AMRA-MS-67-07; AD-669615)

Dispersion-strengthened metals offer potential usefulness at temperatures up to ninety percent of their melting temperatures because of their outstanding mechanical stability at elevated temperatures. In addition, most physical and chemical properties are relatively unaffected by the presence of an inert dispersion. Thus, design engineers may be able to select the base metal alloy for properties other than its strength and then incorporate a dispersion in it to obtain the required strength. At present, dispersion-strengthened alloys of aluminum, copper, nickel, and tungsten are commercially available, and alloys of several other refractory, ferrous, and nonferrous metals are being developed. The metallurgical and design characteristics of these alloys are reviewed in this paper. Author (TAB)

N68-29772 Rice Univ., Houston, Tex.

THE HALL AND NERNST EFFECT IN Bi AND Bi–Sb ALLOYS

Sunil Narayan Shabde (Ph.D. Thesis) 1967 87 p

Available from Univ. Microfilms: HC $4.60/MF $3.00 Order No. 67-13120

The Hall and the thermomagnetic effects have been measured at low magnetic fields between 80°K and 300°K in pure Bi and Bi–Sb alloys. The alloys used had 5% and 12% (atomic) Sb concentrations. Two different crystal orientations were used to measure these effects. The Hall coefficient R_{21} is small and positive. It increases in the magnitude as $1/ne$ would increase with Sb doping at a particular temperature. Since R_{21} equals $1/ne$ times a function which is sensitive to the changes in electron to hole mobility-ratios, it seems that the mobility ratios do not change with Sb dopings. The Nernst coefficient shows an anomalous behavior between 80°K and 300°K. A change of sign is observed in the alloys for the orientation #2a, while no change of sign occurs for the orientation #1a. Further, there is no change of sign in pure Bi for both the orientations. All these results on low field Nernst coefficient can be explained by considering the anisotropy in the Nernst coefficient. Dissert. Abstr.

N68-29796 Rice Univ., Houston, Tex.

CHEMISORPTION ON ZINC OXIDE POWDER

Andrew Koebel Schwartz, Jr. (Ph.D. Thesis) 1967 131 p

Available from Univ. Microfilms: HC $6.40/MF $3.00 Order No. 67-13119

The conductivity measured at both low frequency and radio frequency and the Seebeck E.M.F. of compressed pellets of Zinc oxide powder has been studied in the temperature range 125°–200°C and in atmospheres of oxygen, carbon monoxide, carbon dioxide, and in mixtures of these gases, and also in nitrogen and water vapor. These data are analyzed in the light of the electron theory of chemisorption and catalysis combined with other theoretical work concerning the differences in measurements made on powders and on single crystals of the same substances. The theory is extended to predict reaction rates of carbon monoxide oxidation from single component chemisorption rate data and from electrical measurements while the reaction is in progress. Dissert. Abstr.

N68-29852*# Harvey Engineering Labs. for Research and Development, Torrance, Calif.

DEVELOPMENT OF TECHNIQUES FOR CONTROLLING WARPAGE AND RESIDUAL STRESSES IN WELDED STRUCTURES Final Report

Donald Q. Cole Huntsville, Ala. NASA Jul. 1968 85 p

(Contract NAS8-21174)

(NASA-CR-61235) CFSTI: HC $3.00/MF $0.65 CSCL 20K

This document is the final report of a series of experimental studies performed to determine the feasibility of alleviating warpage and residual stresses in welded aluminum structures applicable to the Saturn program. The studies were performed by altering the thermal pattern during the welding operation using local applications of cryogenic liquids and auxiliary heat to counterbalance thermal stresses produced by welding. Results of the work have definitely demonstrated that such control is possible. For some welded samples, warpage has been reduced to zero, and residual stresses have been reduced to values as low as 5 percent of those present in conventionally welded samples. Sufficient data has not yet been accumulated for establishing optimum thermal patterns for specific weldments, but it is indicated that such patterns can be established empirically in relatively short time. Author

N68-29910 Clarkson Coll. of Technology, Potsdam, N. Y.
EFFECT OF PLASTIC DEFORMATION ON THE ELECTRICAL RESISTIVITY OF NICKEL AND IRON
Kenneth Helmer Thygesen (Ph.D. Thesis) 1967 86 p
Available from Univ. Microfilms: HC $4.60/MF $3.00 Order No. 67-12511

High purity polycrystalline wires of nickel and iron were deformed by tension to strains of up to 9%. The relative change in resistivity as a function of strain was determined for nickel at five different temperatures in the range from 77°K to 393°K and for iron at five temperatures in the range 113°K to 263°K. Stages 2 and 3 of plastic deformation were well defined in nickel. A new equation for the relative change in resistivity as a function of strain in stage 2 was developed which agreed with experimental results. The empirical equation $\Delta\rho/\rho = A\varepsilon_p$ was used to compare results among the experiments. For iron, the value of p changed from 1.2 at 113°K to 1.1 at 263°K, and for nickel in stage 3, p changed from 1.7 at 77°K to 1.3 at 263°K. The value of p for nickel in stage 2 was 1.8. Dissert. Abstr.

N68-29911# Boeing Co., Renton, Wash. Airplane Div.
STRENGTHENING MECHANISMS IN DISPERSION HARDENED NICHROME
Donald Webster 1968 46 p refs
(D6-19773; AD-669208)

The strengthening mechanisms in TD Nichrome was examined at temperatures between 70F and 2000F. A contribution to strength at all temperatures comes from solid solution hardening, dispersion hardening and dislocation substructure hardening. Grain size hardening is operative only below 800F; at higher temperatures a fine grain size results in a loss of strength. The contribution of dispersion hardening is almost constant up to 1000F and then drops sharply. Dislocation substructure strengthening becomes increasingly important as the testing temperature is increased and is the major strengthening factor at 2000F. Author (TAB)

N68-29954*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SOME OBSERVATIONS CONCERNING THE OXIDATION OF THE COBALT-BASE SUPERALLOY L-605 (HS-25)
James S. Wolf and Gary D. Sandrock Washington Aug. 1968 40 p refs
(NASA-TN-D-4715) CFSTI: HC $3.00/MF $0.65 CSCL 11F

The concentration of the minor alloying elements silicon and manganese were found to strongly affect the oxidation behavior of L-605 in the temperature range 1000° to 1200°C. Silicon is also dominant in determining the post-aging ductility of this alloy. Plots were developed which indicate that it is possible to optimize both oxidation resistance and ductility of L-605 by restricting the silicon and manganese concentrations to the range 0.1 to 0.4 and 1.4 to 1.65 weight percent, respectively. A mechanism compatible with observed weight gains, scale structures, and scale compositions was proposed for the oxidation of L-605 and similar alloys. Author

N68-29987*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
HIGH TEMPERATURE CREEP-RUPTURE PROPERTIES OF A TUNGSTEN-URANIUM DIOXIDE CERMET PRODUCED FROM COATED PARTICLES
Robert J. Buzzard Washington Aug. 1968 26 p refs
(NASA-TM-X-1625) CFSTI: HC $3.00/MF $0.65 CSCL 11F

Tungsten-50 volume percent uranium dioxide cermets, produced by roll compaction of tungsten-coated uranium dioxide particles and clad with tungsten, were creep-rupture tested at temperatures of 1080° to 1800°C (1975° to 3272°F) and stresses of 1740 to 14,500 psi (12 to 100 MN/m^2). Rupture life values ranged from 1 to 696 hrs. Additional rupture life values were predicted by use of the Manson–Haferd time-temperature parameter. Isotherms for 0.5 and 1.0 percent creep, and the end of second stage creep, also were constructed by use of this parameter. An attempt was made to describe the role of the UO_2 in the cermet's creep-rupture process. Author

N68-29992*# TRW Equipment Labs., Cleveland, Ohio.
GENERATION OF LONG TIME CREEP DATA OF REFRACTORY ALLOYS AT ELEVATED TEMPERATURES
J. C. Sawyer and E. A. Steigerwald Washington NASA Aug. 1968 197 p refs
(Contract NAS3-2545)
(NASA-CR-1115; TRW-ER-7203) CFSTI: HC $3.00/MF $0.65 CSCL 11F

Creep tests were conducted on selected refractory alloys in a vacuum environment for times between 100 and 15,000 hours. Since the ultimate program goal was to provide design data for space electric power systems, particular emphasis was placed on measuring creep extension below 1%. The resulting data were evaluated in terms of the relative properties of columbium, molybdenum, tantalum, and tungsten-base alloys. In the 1800°F to 2200°F temperature range, the molybdenum-base alloys TZC and TZM possess the best creep properties for potential turbine applications. The variability of the creep properties as a function of heat of material was determined for the T-111 alloy. In addition to comparison of alloy creep properties, chemical analysis, metallography, and tensile test data are presented to characterize each of the materials before and after creep testing. Author

N68-30000*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
HOT-SALT-STRESS-CORROSION CRACKING AND ITS EFFECT ON TENSILE PROPERTIES OF Ti–8Al–1Mo–1V TITANIUM-ALLOY SHEET
Dick M. Royster Washington Aug. 1968 36 p refs
(NASA-TN-D-4674) CFSTI: HC $3.00/MF $0.65 CSCL 11F

The concluding phase of an extensive experimental investigation of hot-salt-stress corrosion of the Ti–8Al–1Mo–1V titanium alloy was conducted on self-stressed and tensile specimens of a 0.050-inch- (1.3-mm) thick Ti–8Al–1Mo–1V titanium-alloy sheet (duplex annealed). The self-stressed specimens, with stresses of 50, 25, and 15 ksi (340, 170, and 100 MN/m^2), were dipped in a 3.4 percent sodium cloride (NaCl) solution and exposed at temperatures from 400° to 600°F (480° to 590°K) for exposures up to 20,000 hours. Stress-corrosion cracking was obtained after approximately 17 hours at 600°F (590°K) for the 50 ksi (340 MN/m^2) stress, but no stress-corrosion cracking was noted at 400°F (480°K) at any stress level investigated. The threshold stresses decrease with an increase in exposure temperature and time. The tensile corrosion specimens were coated with a thin layer of salt (NaCl) and exposed at temperatures from 500° to 600°F (530° to 590°K) at 50 ksi (340 MN/m^2) stress for exposures up to 800 hours to develop and grow stress-corrosion cracks. The presence of stress-corrosion cracks resulted in a large drop in elongation and a moderate decrease in tensile strength. The properties deteriorated more for the transverse specimens than for the longitudinal tensile specimens. The residual tensile properties

appeared to be dependent only on the depth of the cracks, regardless of the temperature or time at which the cracks were developed. The stress-corrosion cracks were intergranular, and maximum crack depth could be correlated with exposure time at 550° and 600°F (560° and 590°K). Author

N68-30037 Ohio State Univ., Columbus.
DETERMINATION OF THE RELATIVE THERMODYNAMIC PROPERTIES OF THE IRON–CHROMIUM–NICKEL SYSTEM AT TEMPERATURES NEAR 1600°C
Stephen Warner Gilby (Ph.D. Thesis) 1966 183 p
Available from Univ. Microfilms: HC $8.40/MF $3.00 Order No. 67-2446

The activities in the liquid iron–chromium binary system were determined from N_{Cr} = 0.01 to 0.40 at 1600°C. The activities in the liquid nickel-chromium binary system were determined from N_{Cr} = 0.01 to 0.50 at temperatures near 1600°C. In the liquid iron–chromium–nickel ternary system the activities were determined for the iso-chromium concentrations of N_{Cr} = 0.05, 0.10, 0.20, and 0.30 and nickel concentrations varying from zero to the nickel–chromium binary at temperatures near 1600°C. The activities of both iron and chromium in the iron–chromium system were determined from a measurement of the equilibrium vapor compositions existing above the liquid alloys in a Knudsen-cell. The activities of iron, chromium, and nickel in the iron rich section of the ternary diagram were determined from a Bendix time-of-flight mass spectrometer. The activities of the remaining ternary alloys were determined from a measurement of the equilibrium vapor compositions by the same procedure employed in the iron–chromium binary system. The activities were computed from the modified form of the Gibbs–Duhem equation and two independent sets of reference activities. Dissert. Abstr.

N68-30048# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.
STUDY OF THE THERMAL CONDUCTIVITY OF MIXED URANIUM–PLUTONIUM OXIDES [ETUDE DE LA CONDUCTIBILITE THERMIQUE DES OXYDES MIXTES D'URANIUM ET DE PLUTONIUM]
Jean-Claude van Craeynest and Jean-Claude Weilbacher Mar. 1968 21 p refs In FRENCH; ENGLISH summary
(CEA-R-3488) CFSTI: HC $3.00/MF $0.65

The dependence of the thermal diffusivity of mixed oxides $(U_{0.8}Pu_{0.2})\ O_{2\pm x}$ on the values of x has been measured. It has been found that the thermal diffusivity decreases strongly when x changes from 0 to 0.02. These measurements have been used to calculate the thermal conductivity. From 0° to 2000°C, the thermal conductivity of the stoichiometric oxides is greater than the conductivity of the hyperstoichiometric and hypostoichiometric oxides. Author (ESRO)

N68-30065*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMPATIBILITY OF SEVERAL IRON-BASE, COBALT-BASE, AND NICKEL-BASE ALLOYS WITH REFLUXING POTASSIUM AT 1800°F
John H. Sinclair Aug. 1968 20 p refs
(NASA-TM-X-1617; E-4337) CFSTI: HC $3.00/MF $0.65 CSCL 11F

Capsules of HS-25, Rene 41, Hastelloys N, C, and X, and AISI 318 were corrosion tested with refluxing potassium at 1800°F (982°C) for times up to 2000 hours. The objective was to determine the corrosion resistance of these alloys for possible use in facilities for ground testing of design concepts for space-power systems. Only AISI 318 appeared to be unsuitable from the standpoint of resistance to corrosion by potassium. The materials could arbitrarily be ranked into three groups in descending order of resistance to corrosion: Rene 41 and HS-25; then, Hastelloys N, C, and X (in that order); and finally, AISI 318. Author

N68-30067 Pittsburgh Univ., Pa.
MEASUREMENTS OF THE INFRA-RED ABSORPTION OF METALS AT LOW TEMPERATURES
Abel Ibude Guobadia (Ph.D. Thesis) 1966 56 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-9714

The infrared absorptivities of bulk, annealed, electropolished specimens of aluminum, copper, lead, and nickel have been measured at 4.2°K in the spectral range 0.9μ–10.9μ, using a calorimetric method. The data are analyzed taking into account electron-phonon generating collisions within the skin-depth volume and the diffuse scattering of electrons at the metallic surface. Close agreement between measurements and theory exists in copper for all wavelengths $\lambda > 1.5\mu$, in lead for $\lambda > 2.0\mu$, and in aluminum for all wavelengths $> 4.0\mu$. In the entire spectral range of the observations, there exists in the case of nickel, a large residual absorption which cannot be accounted for by the summed contributions of the electron-phonon generating collisions and the diffuse scattering of electrons at the metallic surface. It is suggested that perhaps there may exist in a ferromagnet at low temperatures, an additional mechanism for the loss of electromagnetic energy when the conditions $h\omega >> k\theta_c$ (θ_c is the Curie temperature) and $h\omega >> k\theta$, $h\omega >> kT$, are satisfied. The conduction electrons on absorbing a photon may generate spin-waves in a manner analogous to the phonon-generating collisions within the skin-depth volume. Dissert. Abstr.

N68-30068*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CHROMIUM AND NICKEL POWDERS MADE BY REDUCTION OF THEIR OXIDES WITH MAGNESIUM, LITHIUM, OR SODIUM VAPORS
Alan Arias Aug. 1968 23 p refs
(NASA-TN-D-4714; E-4386) CFSTI: HC $3.00/MF $0.65 CSCL 11F

Chromium powder separable into 0.0068-μm colloidal and 0.16-μm coarse powder fractions was obtained by reduction of Cr_2O_3 with Mg vapor in a vacuum furnace. The coarse powder fraction was calculated to have 8 volume percent residual MgO plus $MgO{\cdot}Cr_2O_3$ dispersoids, probably suitable for dispersion strengthening. Other chromium powders, 0.08- to 0.60-μm particle size and oxygen to surface area ratios of about 0.002 g/m², were made by reduction of Cr_2O_3 with Li and Na vapors. Nickel powder, 1.25-μm particle size and with 0.114 percent oxygen, was made by reduction of NiO with Li vapor. Author

N68-30117 Michigan State Univ., East Lansing.
A STUDY OF THE RELATIONSHIP BETWEEN THE YIELD POINT, DELAY TIME AND THE BRITTLE TO DUCTILE TRANSITION IN A LOW CARBON ALLOY
John Hrinevich, Jr. (Ph.D. Thesis) 1967 148 p
Available from Univ. Microfilms: HC $7.00/MF $3.00 Order No. 67-10534

In this investigation ingot iron samples were thermally treated in three different ways to vary the precipitate morphology. Samples were annealed, solution treated, and quenched in iced brine. Modified Izod impact samples, 0.505 inch diameter cylindrical compression samples, and delay time specimens were made from the ingot iron in the three conditions and tested at temperatures between 14 and 305°F to determine the relationship between the behavior of the yield point, delay time, and the transition temperature. The yield point arises when dislocations from the interior of the grain move outward until they meet the grain boundary. At the grain boundary, the dislocations pile-up causing a stress concentration until dislocations in the neighboring grain break away, fresh dislocations are generated in the neighboring grain, the dislocations penetrate the grain boundary and move through the nieghboring grain, or fresh dislocations are generated from grain boundary sources. The important point is that the grain boundary can be a major obstacle. The delay time likewise arises

because the dislocations are not able to move as soon as the stress is applied. In ingot iron the brittle to ductile behavior is related to the precipitates in the grain boundary and thus to the yield point and delay time. Dissert. Abstr.

N68-30124 Illinois Univ., Chicago.
THERMAL DECOMPOSITIONS AND PHASE IDENTIFICATION IN THE ZIRCONIUM OXIDE-CALCIUM OXIDE-PHOSPHORUS PENTOXIDE SYSTEM
Albert Heinrich Bremser (Ph.D. Thesis) 1967 70 p
Available from Univ. Microfilms: HC $3.80/MF $3.00 Order No. 67-11826

The thermal decomposition of ZrP_2O_7, $(ZrO)_2P_2O_7$, and $CaZr(PO_4)_2$ was investigated. Phase identifications were also made in the high ZrO_2 portion of the ZrO_2–CaO–P_2O_5 system after selected compositions had been heated to high temperatures. Over the temperature range of 1450°C to 1700°C the compounds ZrP_2O_7, $(ZrO)_2P_2O_7$, and $CaZr(PO_4)_2$ were found to decompose, expelling P_2O_5 as a vapor, according to first order reaction kinetics. Quantitative data for the rate of decomposition of these compounds at various temperatures were obtained. The compound $Zr_2(PO_4)_4$ was found to exist, although there were indications that it is metastable. The ZrP_2O_7–$CaZr(PO_4)_2$ join was characterized by a eutectic at 1180°C, but no eutectic was found in the join between ZrO_2 and $CaZr(PO_4)_2$. In most cases, where ZrO_2 was identified as one of the final phases after heating the compositions to high temperatures, it was in the monoclinic form. Cubic zirconia was found only in regions where the content of the P_2O_5 was low and that of the CaO high. Dissert. Abstr.

N68-30139# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
REGULARITIES OF DISPERSION OF ENDURANCE LIMIT OF STRUCTURAL ALUMINUM ALLOY [ZAKONOMERNOSTI RASSEYANIYA PREDELA VYNOSLIVOSTI KONSTRUKTSIONNOGO ALYUMINIEVOGO SPLAVA]
M. N. Stepnov 8 May 1967 20 p refs Transl. into ENGLISH from Mashinovedeniye (USSR), no. 4, 1965 p 93–102
(FTD-MT-66-79; AD-670117)

Gauss and Weibull distribution functions are used for calculating the distribution of endurance limits for aluminum AV structural alloy. The calculations are based on the results of endurance tests of 1510 specimens 8 mm in diameter subjected to cantilever bending at 6000 rpm with maximum stresses of 23, 20, 18, 16.5, 15 and 13 kg/sq mm. Statistical analysis of the test data indicates that a normal distribution law is applicable to these results and that Weibull distribution is contradictory in this case. The scatter of the endurance limits depends on the number of test cycles: as the number of cycles is increased, the spread in the endurance limits decreases. The coefficient of variation for the endurance limit is several times greater than the coefficient of variation for the breaking point. The uniformity of the alloy, and consequently the safety factor, is considerably dependent on the alloy structure. An increase in the degree of recrystallization of the alloy reduces the mean endurance limit and noticeably increases the scatter in endurance characteristics. Contamination of the alloy by oxide films has a similar effect on the endurance characteristics. Therefore, it is extremely important to use an alloy with a nonrecrystallized structure for critical parts operating under variable loads. Data on the distribution of the endurance limits for a material may be used for selecting the safety factor in strength calculations under variable loads. Author (TAB)

N68-30160# Aeronautical Research Labs., Melbourne (Australia).
THE EFFECT OF SHOT PEENING ON THE STRESS-CORROSION PROPERTIES OF ALUMINUM ALLOY D.T.D. 5054
G. A. Hawkes Jan. 1968 16 p refs
(ARL/MET-52) CFSTI: HC $3.00/MF $0.65

Stress corrosion data have been obtained from shot peened specimens cut in the short transverse direction from an aluminium alloy extrusion to specification D.T.D. 5054. The specimens were prepared for test in three different ways, to obtain three different residual macro stress systems, typical of the conditions in which the alloy is used in service; it has been shown that, after shot peening, the stress-corrosion properties of each of the three groups of specimens have been improved to a marked extent. X-ray diffraction studies on the specimens have shown that for the particular intensity of peening employed, the resulting highly stressed compressive layer on the surface is of the order 0.006 in. thick and that all evidence of the pre-peening residual stress on the specimen surface has been obliterated. The residual stress measurements show that the balancing tensile stresses are distributed through the remainder of the section rather than concentrated in peak form immediately below the induced surface compression. Author

N68-30183*# Techtran Corp., Glen Burnie, Md.
THE EFFECT OF THE MEDIUM AND OF ADSORPTION LAYERS ON PLASTIC FLOW OF METALS [VLIYANIYE SREDY I ADSORBTSIONNYKH SLOYEV NA PLASTICHESKOYE TECHENIYE METALLOV]
P. A. Rebinder and Ye. K. Venstrem Washington NASA Jul. 1968 16 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR (Moscow), v. 2, no. 4–5, 1937 p 531–548
(Contract NASw-1695)
(NASA-TT-F-11737) CFSTI: HC $3.00/MF $0.65 CSCL 11F

The plastic flow of metals (tin, lead, and copper) before rupture and plastic rupture are considerably facilitated (accelerated) by introduction of small quantities of surface active materials into the nonpolar (hydrocarbon) liquid (pure vaseline oil) in which the experiments are performed. The dependence of this effect on the concentration of the surfactants is investigated in detail. It is shown that the greatest effect is achieved at concentrations corresponding to complete saturation of a monomolecular adsorption layer. At high concentrations, the effect decreases once more. The relationship of these phenomena to the facilitation of brittle rupture (dispersion) of solid bodies under the influence of absorbed materials and to the "cleaving influence" of thin liquid layers is established. The significance of this effect of "internal lubrication" in the effect of lubricating-cooling fluids during metal working by pressure and by cutting is indicated. Author

N68-30187# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
OXIDATION PROTECTION OF REFRACTORY METALS BY INORGANIC COMPOUNDS
G. Geschwind Jul. 1968 40 p refs To be presented at the 14th Natl. SAMPE Symp., Cocoa Beach, Fla., Nov. 1968
(RM-4170)

In this study of the oxidation of refractory metal powders in the presence of inorganic compounds, oxidation was followed by differential thermal analysis (DTA) of the metal-compound mixture in still air at a constant heating rate. The temperature at which oxidation started could be determined, as well as the temperature at which the maximum rate of oxidation of the powder occurred (the explosion temperature). While this initial investigation was concerned primarily with fluoride salts, some other high melting compounds were also studied in conjunction with the refractory metals Ta, Nb, W, and Mo. The salts provided the generally best protection with Ta; they provided less protection with Nb and W, and almost none with Mo. The largest increases in protection provided by the salts (≈200°C) were observed in the systems Ta:LiF, Ta:NH_4HF_2, and Nb:KHF_2. The best protection was provided by Li_2O, however, which, besides being the only compound to protect all four metals, increased the protection of Ta and Nb by 300°C and 500°C, respectively. Explanations are offered for the protection and its eventual breakdown based on the

chemisorption of ions onto the metal surface and the resulting bond between the surface atoms and the adsorbed ions. It is believed that this investigation opens new avenues in the study of oxidation protection. Author

N68-30221*# Techtran Corp., Glen Burnie, Md.
ON THE CORROSION RESISTANCE OF METALB IN FREON [PRO KOROZIYNU STIYKIST METALLIV U FREONI]
G. V. Karpenko, V. I. Pokhmurs'kiy, V. G. Protsik, and S. I. Rusin Washington NASA Jul. 1968 3 p refs Transl. into ENGLISH from Dopovidi Akad. Nauk Uk. RSR, Ser. A Fiz.-Tekh. and Mat. Nauk (Kiev), no. 2, 1968 p 178–180
(Contract NASw-1965)
(NASA-TT-F-11864) CFSTI: HC $3.00/MF $0.65 CSCL 11F

The authors show that many metals and alloys are subject to corrosion in freon-11 when the temperature is raised to 300 degrees C and the pressure increased up to 60 atm. The most corrosion-resistant proved to be Kh17N2 steel. The 20, 45, U8, and 4Kh13 steels also proved to be sufficiently resistant. At the other extreme, copper and brass were found to be the least resistant. These metals turned into a shapeless mass after a short period of time. Also quite non-resistant were the VTZ-1 titanium alloys and VD-17 aluminum alloy. Author

N68-30233*# Massachusetts Inst. of Tech., Cambridge. Dept. of Metallurgy and Materials Science.
RESEARCH ON MECHANISMS OF ALLOY STRENGTHENING Semiannual Report
Nicholas J. Grant Jun. 1968 18 p *Its* Suppl. No. 8
(Contract NGL-22-009-003)
(NASA-CR-95871) CFSTI: $3.00 CSCL 11F

An overview is presented on the various research projects being conducted to study the strengthening mechanisms of oxide dispersed alloys, and to determine the potential of rapidly quenched, atomized, or splat cooled particles and flakes for improving high strength alloy systems. The sintered aluminum powder technique for oxide dispersion strengthened copper–aluminum–Al_2O_3 is discussed, and data are tabulated on the compositions of the A and B alloys, and on tensile tests at 20° and 450°C. The role of oxide contaminants and reactive solute metals in oxide dispersed alloys is being examined, with emphasis placed on three heat-resistant alloys: type 316 stainless steel, 80 Ni–20 Cr alloy, and 80 Fe–20 Cr alloy. The refractory oxides are ThO_2 and BeO. The equipment improvments to permit splat cooling on a continuous basis are enumerated. It is also reported that a protective atmosphere was introduced during alloy melting and quenching to study the splat cooling of Al–Cu, Al–Fe, Al–Ni, and Al–Pd alloys. Preliminary calculated values of the lattice parameters of metastable supersaturated Al–Pd and Al–Fe alloys are depicted. M.G.J.

N68-30253#
ON THE EXPERIMENTAL VERIFICATION OF THE TEMPERATURE DISTRIBUTION IN THE AREA OF LASER RADIATION ACTION ON A METAL (E/T)
V. P. Veiko, A. N. Kokora, and M. P. Libenson 1968 5 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 179, no. 1, Mar. 1968 p 68–71 Presented at the All-Union Sci. Res. Inst. of Light and Textile Machine Construct., 29 Apr. 1967
CFSTI: HC $3.00/MF $0.65

An experimental study of existing computational methods devoted to the analysis of the temperature distribution in materials, particularly metals, heated by laser radiation without fracture of the surface is reported. Focused on is the temperature distribution in steels where hardening of the surface layer occurs under the effect of the laser radiation. Experiments were conducted with a neodymium laser with 7.5 j pulsed radiation energy for a 4 msec duration. Satisfactory agreement between the computed and experimental values of temperature was observed, although it was assumed that: (1) the thermophysical and optical constants of the material were temperature independent; and (2) the real time and space structure of the laser pulse, which was replaced by a rectangular pulse with uniform intensity distribution in the light spot, was neglected. On the basis of obtained results it is concluded that the proposed method of evaluating the temperature in the material can be used for engineering calculations, as for example, for heat treatment and surface hardening. It is also shown that by using the proposed method, the accuracy of thermal computations may be estimated in the presence of material evaporation under the effect of laser radiation; and moreover, isotherms of the phase transitions, melting and hardening, may be constructed according to the results of a metallographic analysis and compared with computed results. S.C.W.

N68-30255 European Atomic Energy Community, Brussels (Belgium).
STEEL PROGRAM AT EURATOM—OUTLINE OF RESULTS OBTAINED IN THE PERIOD 1961 TO 1964, ADAPTED FROM A COMPILATION IN FRENCH BY J. SEBILLE
Jun. 1968 231 p refs
(Contract EURATOM-105-66-11 TEEN)
(EUR-3784.e; EURAEC-1986) CFSTI: $3.00

This survey contains various studies on embrittlement processes which affect steels used in the vessels of light water cooled reactors. Research centered on irradiation effects, fabrication processes, non-destructive testing methods, steel properties, and metallurgical factors encouraging embrittlement. G.G.

N68-30307# Joint Publications Research Service, Washington, D. C.
RESEARCH ON TREATMENT OF METALS
12 Jul. 1968 23 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Met. (Moscow), no. 3, May–Jun. 1968 p 88–93, 106–108 and 118–120
(JPRS-45912) CFSTI: HC $3.00/MF $0.65

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N68-30308# Joint Publications Research Service, Washington, D. C.
REDUCTION OF TANTALUM PENTACHLORIDE BY HYDROGEN ON A HEATED SURFACE
Ya. M. Polyakov, I. F. Lisonvik, and A. N. Krestovnikov *In its* Res. on Treat. of Metals 12 Jul. 1968 p 1–9 refs (See N68-30307 18-17)

Thermodynamic calculations and experimental studies were made to determine tantalum yield from the reduction of tantalum pentachloride by hydrogen on a heated surface. Tantalum yield in the absence of a stream of vapor-gas mixture is tabulated, as are data from calculating the equilibrium conversions as a function of the temperature of the reduction process and the concentration of the tantalum pentachloride. Heats of formation, entropies, and heat capacities are given hydrogen, hydrogen chloride, tantalum, and tantalum chlorides. M.W.R.

N68-30309# Joint Publications Research Service, Washington, D. C.
ELECTROLYTIC REFINING OF ZIRCONIUM CARBIDE
A. B. Suchkov, G. A. Meerson, and Yu. G. Olesov *In its* Res. on Treat. of Metals 12 Jul. 1968 p 10–14 (See N68-30307 18-17)

Optimal conditions were established for the electrolytic refinement of zirconium carbide from which macrocrystalline deposits of technically pure metal were obtained; and zirconium yield from the anode material was as high as 91.7%. For electrolytic refinement of the carbide, additional energy is required that is equal to the change in the isobaric potential during carbide formation. Electrorefinement was carried out in an electrolyzer at 500 amp and the zirconium carbide for the anode was obtained by treating zirconium dioxide with carbide black at 2200°C. M.W.R.

N68-30310# Joint Publications Research Service, Washington, D. C.
RESEARCH ON ROLLING METALS UNDER VACUUM
A. V. Krupin and I. M. Pavlov *In its* Res. on Treat. of Metals 12 Jul. 1968 p 15–20 refs (See N68-30307 18-17)

A vacuum twin rolling mill was designed, manufactured, and placed in operation for studying the processes and phenomena occurring during rolling in a vacuum and inert media. A thermodynamic analysis of the effect of a vacuum was conducted, conditions of nonscale deformation were determined, and the flow kinetics of the oxidation reactions were studied. Conditions of rolling were studied in relation to the parameters of the process and the structure and properties of copper, molybdenum, niobium, rhenium, tantalum, tungsten, vanadium, and zirconium metals and alloys as well as some bimetals. Decreasing the thickness of oxide films or their elimination from metal surfaces was found to cause sticking of the metal on the mill rollers. The positive effect of the vacuum was seen in the significant increase in the corrosion resistance of bimetals. After 14 months, titanium alloy-bronze samples suffered deterioration in the bronze but not in the transition layer; and titanium alloy-stainless steel samples remained in the same medium for 2 years without visible signs of deterioration. M.W.R.

N68-30324# Bettis Atomic Power Lab., Pittsburgh, Pa.
THE CORROSION AND HYDROGEN ABSORPTION CHARACTERISTICS OF ZIRCONIUM ALLOYS CONTAINING 2.5% TIN AND ADDITIONS OF IRON, CHROMIUM, AND NIOBIUM
Stanley Kass Feb. 1968 50 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-TM-619) CFSTI: HC $3.00/MF $0.65

The corrosion and hydrogen absorption characteristics of zirconium base alloys containing 2.5% tin in high temperature water and steam were studied. All alloys exhibited higher strength characteristics, without losses in ductility, than did the Zircaloys. Three alloys showed very low hydriding tendencies after exposure to high temperature water. Author (NSA)

N68-30327# General Motors Research Labs., Warren, Mich. Materials and Structures Lab.
SPALLATION THRESHOLDS OF N50A BERYLLIUM
R. L. Warnica Jan. 1968 29 p refs Prepared for Calif. Univ., Livermore
(Contract W-7405-ENG-48)
(UCRL-13339; MSL-68-1) CFSTI: HC $3.00/MF $0.65

In the experimental tests to determine the incipient spallation thresholds of N50A beryllium, precisely controlled pulses were obtained by planar impacts of N50A berlyllium discs against targets of the same material. Four submicrosecond loading times were investigated and results show this alloy to have time dependent incipient spallation thresholds. The thresholds were determined at impact velocities of approximately 370, 245, 230, and 190 fps for times of loading of 40, 200, 400, and 800 nanoseconds, respectively. Author (NSA)

N68-30426# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
STRUCTURE STUDY OF AN AMORPHOUS ELECTRODEPOSITED NICKEL-PHOSPHORUS ALLOY
B. G. Bagley and D. Turnbull Apr. 1968 23 p refs
(Contracts N00014-67-A-0298-00009; ARPA SD-88)
(TR-17; AD-669813)

The radial distribution function for an electrodeposited amorphous nickel-phosphorus (14.9 wt % P) alloy has been determined. The atomic distribution was found to be similar to that in a monatomic liquid metal, and more disordered than that observed in an amorphous nickel-phosphorus alloy produced by chemical deposition. Two transformations (both exothermic) were observed in this alloy; the first of which occurred at 280 plus or minus 2C with an energy of 18.5 cal/gm (980 cal/gm atom) and the second at 410 plus or minus 5C with an energy of 6.0 cal/gm (310 cal/gm atom). As deposited the alloy exhibits only a very weak small angle X-ray scattering, apparently not due to the presence of the phosphorus. Author (TAB)

N68-30445# Naval Research Lab., Washington, D. C.
DSSP PROGRAM ON HIGH-STRENGTH MATERIALS (EVALUATION OF AN EXPERIMENTAL TITANIUM-FREE MARAGING STEEL)
Fred R. Stonesifer, Herschel L. Smith, and Hugh E. Romine Apr. 1968 31 p refs
(NRL-MR-1869; AD-670484)

The report begins with a short explanation of why a large titanium content was thought to be a detrimental to toughness of maraging steels. Several metallurgists have identified the fracture nucleating particles in maraging steels as titanium nitrides and titanium carbides. An experimental 'titanium-free' maraging alloy was developed. Two heats were tested; one was of laboratory quality, and one of a quality as might be expected from production heats. Both base plate and welded samples are considered from each heat. Welding with the new titanium-free alloy proved to be a problem which has not yet been solved. At best the new alloy offered only a slight improvement over the normal alloy. The required high purity and difficulty with welding make use of this new alloy impractical at the present time. Author (TAB)

N68-30470# Kentucky Univ., Lexington. Dept. of Engineering Mechanics.
DYNAMIC TEMPERATURE MEASUREMENT DURING THE AXIAL IMPACT OF ANNEALED ALUMINUM TUBES
Benson T. Taylor, Jr. Apr. 1968 70 p refs
(Contract AF 49(638)-1646)
(AFOSR-68-0826; AD-670171)

Experimental temperature data produced in annealed aluminum tubes during an axial impact of 0.005 seconds duration are presented for strains of magnitudes from 50 to 5,000 microns in/in. The results approximately agree with the energy equation reported herein, but the data have a large variation which is attributed to impacts which are not perfectly axial. The temperature associated with the elastic volume changes which occur during plastic deformation is shown to be large compared to the plastic work. The stored energy of the dynamic impact is shown to be of the same order of magnitude as the static stored energy of cold work for annealed aluminum. The test specimen consisted of a short soft section which is ten inches long glued to a long hard aluminum tube of the same cross-section. This type specimen produced a more uniform strain field and permitted heat conduction to be neglected during impact. Author (TAB)

N68-30473# College of Aeronautics, Cranfield (England). Dept. of Materials.

WELDING EMBRITTLEMENT OF THE PARENT PLATE OUTSIDE THE VISIBLE HEAT AFFECTED ZONE REGION

M. D. Coward Apr. 1968 8 p refs
(COA-NOTE-MAT-19) CFSTI: HC$3.00/MF$0.65

The problem of embrittlement of steels outside the visible heat-affected zone region due to plastic straining from the weldment and subsequent aging is reviewed. An attempt is made to detect this region in a semi-killed mild steel by means of a microhardness testing survey taken at regular intervals in a direction away from the weld fusion boundary. Recommendations for future work in understanding the magnitude of this problem particularly in multistressed welded joints are given. Author

N68-30484# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE RELATION OF THE PRECIPITATION PROCESSES TO THE PROPERTIES OF CORROSION-RESISTANT STEELS [VZTAH PRECIPITACNICH PROCESU K VLASTNOSTEM KOROZIVZDORNYCH OCELI]

Vladimir Cihal and Oldrich Vanicek 8 Nov. 1967 17 p refs Transl. into ENGLISH from Kovove Mater. (Bratislava), v. 3, no. 2, 1965 p 161–170
(FTD-HT-67-223; AD-670100)

The authors trace the structural changes in stabilized stainless steels with respect to selective types of corrosion. Main consideration is given to delta ferrite and its decomposition in 1Cr18Ni9Ti steel. The electron microscope was used to advantage in the study of changes taking place in ferrite. Apart from the carbide precipitation, which initiates the ferrite decomposition, two phases, sigma and austenite, form from delta ferrite. The sigma phase in stabilized steels starts with the formation of lamellae at the grain boundaries between austenite and ferrite and spreads gradually inside the delta ferrite grains. The local change in chemical composition during the ferrite decomposition is one of the main causes of increased attack in the given type of steel in the transpassive state. The selective attack on welded joints in these steels (at the weld junction) is closely associated with these structural changes and shows up especially well during treatment with hot concentrated nitric acid. Author (TAB)

N68-30487# Bureau of Mines, College Park, Md. Metallurgy Research Center.

CORROSION PROPERTIES OF THE TZM AND MOLYBDENUM-30 TUNGSTEN ALLOYS

W. L. Acherman, J. P. Carter, and David Schlain Aug. 1968 23 p refs
(BM-RI-7169)

The Bureau of Mines found the chemical and galvanic corrosion behavior of the TZM and molybdenum-30 tungsten alloys to be generally equal or superior to that of unalloyed molybdenum in many aqueous solutions of acids, bases, and salts. Notable exceptions occured in 1 N nitric acid, where both alloys corroded appreciably faster than molybdenum. In mercuric chloride solutions, the TZM alloy was susceptible to a type of crevice corrosion which was not due to differential aeration. The alloys were usually not adversely affected by contact with dissimilar metals in galvanic couple experiments, but the dissimilar metals sometimes corroded galvanically. Both alloys were resistant to substitute ocean water spray at 60°C. Author

N68-30504*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

TENSILE PROPERTIES OF TANTALUM AND TUNGSTEN 10-FIBER BUNDLES AT 1000° F (812 K)

Ruluff D. McIntyre Washington Aug. 1968 21 p refs
(NASA-TN-D-4725) CFSTI: HC$3.00/MF$0.65 CSCL 20K

This investigation studied the tensile properties of 10-fiber bundles and related these properties to single-fiber strength. Bundles comprised of both tantalum and tungsten fibers with 20, 50, and 80 percent tungsten fibers were also tested. A statistical study related bundle strengths to single-fiber strengths. Bundles of tungsten fibers were less strong than single fibers tested separately. Bundles of tantalum fibers were as strong as tantalum single fibers. Strength followed the rule of mixtures for bundles containing mixtures of tantalum and tungsten fibers. Author

N68-30510# College of Aeronautics, Cranfield (England).

THE INFLUENCE OF NITROGEN ON THE PROPERTIES OF MILD STEEL WELD METAL DEPOSITED FROM COVERED ELECTRODES

J. Wegrzyn and R. L. Apps [1967] 30 p refs
(CoA-MAT-4) CFSTI: HC$3.00/MF$0.65

The nitrogen content of weld deposits from acid, rutile, and basic covered electrodes was determined, and the influence of electrode drying temperature and supplementary gas shielding measured. Basic covered electrodes were found to deposit lower nitrogen contents than acid or rutile deposits. Drying at temperatures up to 800°C was found to increase the nitrogen content and decrease the hydrogen content of acid and rutile weld deposits, but supplementary gas shielding with CO_2, A or H_2 reduced the nitrogen content to very low levels. The nitrogen content was also influenced by the thickness of the electrode coating and the composition of the weld deposit. Increase in nitrogen content was found to increase the yield and tensile strengths of mild steel weld deposits for both room and elevated temperatures at the expense of ductility and notch toughness. Nitrogen was also found to influence the incidence of fissuring and cracking in weld deposits: with nitrogen contents of 0.007% no fissuring was found even in the presence of high hydrogen contents. Author

N68-30523# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INFLUENCE OF TOOL SHAPE ON NATURE OF DEFORMATION OF NONPLASTIC STEEL ON UPSETTING [VLIYANIYE FORMY INSTRUMENTA NA KHARAKTER DEFORMATSII MALOPLASTICHNOY STALI PRI OSADKE]

V. I. Zalesskiy, Yu. I. Kozlov, and M. S. Tsibanova 15 Sep. 1967 12 p Transl. into ENGLISH from Kuznechno-Shtampovochnoye Proizv. (USSR), no. 10, 1965 p 9–10
(FTD-HT-67-255; AD-670067)

Considering that many low-plasticity alloys are forged by upsetting and that initially concave and convex spherical upset dies and punches are used for this operation while flat upset dies and punches are used for final upsetting, the effect of the configuration of upset tools on plasticity as well as on the nonuniformity of deformation over height of specimen was investigated under laboratory conditions. Author (TAB)

N68-30531# Los Alamos Scientific Lab., N. Mex.

ADDITION OF RARE EARTHS TO URANIUM AND URANIUM ALLOYS

G. E. Jaynes 8 May 1968 20 p ref
(Contract W-7405-ENG-36)
(LA-3911) CFSTI: HC$3.00/MF$0.65

The rare earths thulium, lutetium, and yttrium were added to uranium and uranium alloys in the range of 0.1 to 0.3 wt %. Nickel, cobalt, and rhodium were used as carrier metals for the rare earths. These carrier metals are partially soluble in uranium and also exhibit partial solubility for the rare earths. The room temperature tensile strength, yield strength, elongation, calculated modulus, and hardness were obtained for both as-rolled and vacuum-annealed sheet stock. Grain size, hardness, and density values were obtained on the as-cast alloys for comparison. Author (NSA)

N68-30559# Army Missile Command, Huntsville, Ala. Physical Sciences Lab.
STRENGTH RESULTS FOR CERAMIC MATERIALS UNDER MULTIAXIAL STRESSES
Richard E. Ely 15 Apr. 1968 60 p refs
(RR-TR-68-1; AD-670126)

Strength results for short, simple tubular specimens of graphite and boron nitride were obtained for tension-compression stresses. These results agree well with previous data obtained with longer tubular specimens which were not simple cylinders. Preliminary strength results also are given for graphite for a temperature of approximately 2000F. A few room temperature tests were conducted for compression-compression stresses. A unique compression test method was used to test graphite rods where the end surfaces of the rods are loaded by means of fluid pressure. Data for magnesium silicate were reevaluated and compared with the modified maximum strain energy theory. Author (TAB)

N68-30563# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ATLAS OF DIAGRAMS OF STATE OF TITANIUM ALLOYS
Ye. K. Molchanov 29 Aug. 1967 346 p refs Transl. into ENGLISH of the book "Atlas Diagramm Sostoyaniya Titanovykh Splavov" Moscow, Izd. Mashinostr., 1964 p 1–392
(FTD-MT-65-387; AD-670090)

The book gives the phase diagrams of binary and ternary titanium systems based on the results of Soviet and foreign research. A critical review of the literature on this problem, published in the Soviet Union and abroad, is included. The basic properties of titanium base alloys are given. The book is intended for workers in plant laboratories and research institutes of the metallurgical, chemical, and aviation industries. TAB

N68-30569# Argonne National Lab., Ill.
AN EXPLORATORY STUDY OF THE BEHAVIOR OF NIOBIUM AND VANADIUM-BASE ALLOYS IN OXYGEN-CONTAMINATED SODIUM
Harry A. Levin and Sherman Greenberg Jan. 1968 20 p refs
(Contract W-31-109-ENG-38)
(ANL-6982) CFSTI: HC $3.00/MF $0.65

Niobium- and vanadium-base alloys were exposed to oxygen-contaminated sodium at 650°C in a series of exploratory studies. The purpose of these studies was to determine if, based on corrosion (i.e., weight-change) data, any alloys in these systems may be suitable as fuel jacketing in sodium-cooled reactors operating at approximately 650°C. The tests of the niobium and vanadium alloys showed that vanadium alloys have markedly superior corrosion resistance. At oxygen concentrations below approximately 15 ppM, V-20 wt% Ti was the best alloy tested. Author (NSA)

N68-30570# Bhabha Atomic Research Centre, Bombay (India). Metallurgy Div.
EFFECT OF HEAT TREATMENT ON THE MECHANICAL PROPERTIES OF ZR-1% CR, ZR- 0.5% NB, AND ZR- 0.5% NB-1% CR ALLOYS
S. Ray and M. L. Mehta 1967 22 p refs
(BARC-306) CFSTI: HC $3.00/MF $0.65

The present paper reports the effect of heat-treatment on the mechanical properties of Zr- 0.5 wt% Nb, Zr- 1.0 wt% Cr and Zr- 0.5 wt% Nb- 1.0 wt% Cr alloys. The ternary Zr- 0.5 wt% Nb- 1.0 wt% Cr alloy shows much higher strength as compared to Zr 0.5 wt% Nb or Zr- 1.0 wt% Cr alloy, on quenching from 900°C. A study of the mechanical properties of the binary alloys further reveals that chromium is mainly responsible for the higher strength of the ternary alloy whereas niobium seems to be effective in briging about better work-hardening characteristics in it. The ternary alloy, on quenching from 900°C, undergoes martensitic transformation and is stable up to 500°C tempering temperature. Tempering at higher temperatures causes precipitation of chromium as $ZrCr_2$ with an appreciable drop in strength. Author

N68-30578# College of Aeronautics, Cranfield (England).
THE WELD HEAT AFFECTED ZONE STRUCTURE AND PROPERTIES OF TWO LOW CARBON MN-CR-MO-V STEELS
E. Smith, L. J. Brown, and R. L. Apps Feb. 1968 49 p refs
(COA-MAT-3) CFSTI: HC $3.00/MF $0.65

The visible weld heat affected zone (HAZ) of a low carbon, Mn-Cr-Mo-V steel was shown to be made up of four distinct regions: (a) the region of grain coarsening, (b) the region of grain refinement, (c) the region of partial transformation, and (d) the region of spheroidisation. Representative structures from the weld HAZ were reproduced, by means of a thermal simulation technique, in specimens large enough to mechanical testing. The thermal cycles applied were determined on a submerged arc bead-on-plate weld in 1-1/2" thick plate using a heat input of 108 kilojoules/inch. Metallurgical examination and hardness measurements on two steels of this type showed that the simulated regions were comparable with the actual regions of the weld HAZ. The mechanical properties of the simulated HAZ regions were measured and correlated with the metallurgical microstructures. In one of the steels embrittlement occurred in all regions of the HAZ, the region of grain coarsening being the most embrittled. Author

N68-30579# Dow Chemical Co., Golden, Colo. Rocky Flats Div.
THE FORMING OF CONTAINERS FOR MOLTEN NICKEL AND BERYLLIUM AT HIGH TEMPERATURES AND VACUUM
Marvin C. Lunde and Wendelin P. Meier 15 Apr. 1968 13 p refs
(Contract AT(29-1)-1106)
(RFP-882) CFSTI: HC $3.00/MF $0.65

Dense, fine grained crucibles were made by hot pressing the powders of a variety of refractory compounds. The crucibles were tested for resistance to vacuum outgassing, to thermal shock, and to corrosion by molten beryllium and by molten nickel. Heat rates up to 900°C per minute were achieved by electron bombardment heating in vacuum of 3×10^{-5} torr. Titanium diboride was found to be a good container for molten beryllium, and a modified titanium carbide composition proved to be a satisfactory container for molten nickel. Author (NSA)

N68-30580# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
MECHANICAL THINNING OF CERAMIC MATERIALS FOR TRANSMISSION ELECTRON AND OPTICAL MICROSCOPY
T. E. Bauer and R. H. Beauchamp Apr. 1968 15 p refs
(Contract AT(45-1)-1830)
(BNWL-652) CFSTI: HC $3.00/MF $0.65

The application of the high resolving power of the transmission electron microscope to the investigation of multi-phase ceramic compounds and metal–ceramic composites is discussed. The basic problem is one of achieving sufficiently thin specimens. For good transmission electron microscopy, the specimen should be no thicker than 3000 Å (3×10^{5}cm). A mechanical thinning technique is described which consists of polishing one surface of a specimen, then grinding and polishing the opposite surface until the proper thickness is achieved. Specific abrasive materials are listed for each of several materials that have been thinned. Transmission electron micrographs of various materials thinned by mechanical grinding are presented. NSA

N68-30605*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SUPERPLASTICITY IN TUNGSTEN-RHENIUM ALLOYS
M. Garfinkle, W. R. Witzke, and W. D. Klopp Washington Aug. 1968 22 p refs
(NASA-TN-D-4728) CFSTI: HC $3.00/MF $0.65 CSCL 11F

Electron beam melted tungsten–rhenium alloys containing 20 to 28 atomic percent Re exhibited elongations of over 200 percent in tensile tests at 3630°F. Rapid grain growth rates in these alloys, relative to tungsten–rhenium alloys with lesser Re contents, and continuous recrystallization during tensile testing indicate the occurrence of enhanced diffusion processes. Strain rate sensitivities generally ranged between 0.2 and 0.3 for these alloys, but strain rate sensitivities as high as 0.8 were observed under the special conditions encountered immediately following initial recrystallization. These were well within the range associated with superplastic materials. Author

N68-30606# Army Materials and Mechanics Research Center, Watertown, Mass.

INFLUENCE OF CARBON AND OXYGEN ON SOME EXPLORATORY ULTRAHIGH-STRENGTH ALPHA-BETA TITANIUM ALLOYS

Arthur M. Ayvazian and Robert M. Colton May 1968 28 p refs

(AMMRC-TR-68-11; AD-670026)

An examination was made of the alloys to determine the effect of modifying the oxygen and carbon contents normally employed in titanium alloys on their mechanical properties. A total of 51 exploratory ultrahigh-strength alpha-beta titanium alloys were scrutinized. The results indicated that the alloys with low oxygen content, approximately 0.03% to 0.05% by weight, generally possessed lower yield strengths but good ductility and toughness compared to the alloys with higher oxygen contents at 200,000 psi strength levels. The alloys with the lower oxygen content also responded more readily to the 1150 F aging treatment, causing the yield strength to decrease more substantially than those alloys in the higher oxygen content range of 0.09% to 0.11%. The alloys containing 0.04% to 0.08% oxygen and 0.05% to 0.09% carbon exhibited no definite or predictable change in mechanical properties due to the modified oxygen and carbon. The influence of carbon on ductility and toughness was considerably less than that of oxygen. The optimum alloy, No. 7, containing 0.12% carbon and 0.11% oxygen, displayed a yield strength of approximately 220,000 psi, elongation of 11.9%, and impact strength of 5.9 ft-lb at 1150 F aging temperature. The most effective oxygen plus carbon content for each alloy which would develop the optimum mechanical properties appeared to depend on the alloy and the specified yield strength range. Author (TAB)

N68-30635# Army Materials and Mechanics Research Center, Watertown, Mass. Process Lab.

A LITERATURE SURVEY OF THE EFFECTS OF CERTAIN MINOR ELEMENTS ON THE PROPERTIES OF NODULAR IRON

Edward L. Wyatt and Kenneth D. Holmes May 1968 19 p refs

(AMMRC-MS-68-07; AD-670092)

Minor elements often exert an effect on either the metal matrix or the graphite shape. Some elements, such as titanium, tend to cause flake graphite in nodular iron, resulting in low ductility. Other elements, such as tin, favor the formation of pearlite in the as-cast condition and increase time of annealing for ferritic nodular iron. The effects of many elements in nodular iron can be neutralized by cerium and other reactive elements. The effect of any one element is largely dependent on the presence of other minor elements and certain variables such as section size and heat treatment. A discussion is given for the following elements: carbon, silicon, magnesium, manganese, nickel, molybdenum, sulfur, phosphorus, chromium, vanadium, boron, copper, tin, arsenic, antimony, aluminum, lead, titanium, bismuth, tellurium, cerium, and a few other minor elements. Author (TAB)

N68-30669# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

STABILITY AND STRENGTHENING OF NICKEL BASE ALLOYS UNDER EXPOSURE TO THE EFFECT OF MICRO CAVITATION [STOYKOST' I UPROCHNENIYE SPLANOV NA NIKELEVOY OSNOVE PRI MIKROUDARNOM VOZDEYSTVII]

Yu. G. Veksler, V. S. Litvinov, and R. I. Mints 3 Jul. 1967 12 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Chern. Met. (Moscow), no. 1, 1966 p 132–135

(FTD-HT-23-651-67; AD-670093)

The industrial alloys EI437 and EI867 (both of which are hardening nickel base alloys) were subjected to microcavitation in an impact-erosion apparatus and subsequently tested for surface hardness and weight loss. The aging characteristics of the alloys before and after exposure are given. Surface hardnesses were given as a function of testing time for different aging conditions--as-quenched and aged for 8, 25, and 50 hrs. In all cases, the plastic deformation induced by microcavitation resulted in strain hardening; maximum hardness was achieved after 3 to 4 hrs of testing. The alloy EI867 achieved the highest hardness for all relative conditions and the highest rate of strain hardening (55 to 65%) in the as-quenched condition. Sample destruction set in after about 5 to 7 hrs of testing and after the weight losses became considerable (16 to 18 hrs). Surface pitting and scaling were observed in the initial stages of exposure and the amount increased with time. Slip markings were widely scattered for microcavitation deformation when compared with the uniform slip traces observed in compression. The general kinetics and characteristics of microcavitation damage were very similar to Fe-Ni and Cr-Ni alloys. Author (TAB)

N68-30690# Atomic Energy of Canada, Ltd., Chalk River (Ontario).

SOME OBSERVATIONS OF INTEGRANULAR CORROSION ON IRON AND NICKEL [CORROSION INTERGRANULAIRE OBSERVEE SUR DES ALLIAGES DE FER ET DE NICKEL DANS DE L'EAU DE HAUTE PURETE]

P. E. C. Bryant and J. E. LeSurf Apr. 1968 35 p refs Presented at the 24th Natl. Assoc. of Corrosion Engr. Conf., Cleveland, Mar. 1968

(AECL-2800)

Intergranular corrosion has been detected on externally unstressed specimens of plain carbon steel, 68Ni-30Cu, and 75Ni-15Cr-7Fe alloys, following exposures in simulated boiling water reactor loop experiments. Cracks propagated to a depth of three grains, i.e., 2 mils, on plain carbon steel and the Ni-Cu alloy. Intergranular crevices to 1/4 mil, present on as-received Ni-Cr-Fe sheet, propagated to 7 mils. No intergranular attack was initiated or crevice propagation detected on unstressed specimens of these susceptible alloys tested in irradiated pressurized water. Nitrate ion up to 10 ppm did not promote intergranular attack of plain carbon steel and Ni-Cu alloys in the absence of oxygen, but may have contributed to progression of intergranular cracking in plastically deformed Ni-Cr-Fe specimens. Intergranular attack of the susceptible alloys was prevented, and crevice propagation arrested in irradiated boiling water by maintaining the ammonia concentration in excess of 10 mg/kg in the water phase. Oxidizing species, produced from radiolytic decomposition of boiling water are suggested as the primary cause for the observed intergranular corrosion. Author

N68-30720*# Pittsburgh Univ., Pa. Space Research Coordination Center.

MECHANICAL PROPERTIES OF THE GROUP 4B AND 5B TRANSITION METAL MONOCARBIDES

W. F. Brizes 11 Jul. 1968 50 p refs

(Grant NsG-416)

(NASA-CR-95887; SRCC-80) CFSTI: HC $3.00/MF $0.65 CSCL 11F

The mechanical behavior of the Group IVB and Group VB monocarbides have been studied on one hundred percent dense samples made by liquid state carburization. The properties investigated were thermal expansion, yield stress, and room temperature hardness as a function of stoichiometry. The activation energy for deformation of niobium carbide was determined from high temperature yield stress data and was found to be 133K cal/mole, a value that is in good agreement with the estimated activation energy for niobium diffusion in niobium monocarbide. Author

N68-30728# Washington State Univ., Pullman. Metallurgy Dept.
FACTORS AFFECTING THE INITIAL PLASTIC BEHAVIOR OF CLOSE PACKED METAL SINGLE CRYSTALS Final Technical Report, 1 Feb. 1965–31 Jun. 1968
R. F. Tinder 26 Apr. 1968 5 p refs
(Grant AF-AFOSR-833-6)
(AFOSR-68-1109; AD-670228)

Based on the available experimental results the various proposed models used to explain the plastic behavior of crystalline solids in these regions were critically evaluated. These models include the Frank-Read source mechanism, the Koehler multiple-cross-glide mechanism, the Peierls-Nabarro stress, the pinning model, the intersection model and the micro-creep mechanism. Generally, the various results in the microstrain region were explained in terms of these models with the exception of the micro-creep mechanism which has been used to explain initial yielding phenomena in the millimicrostrain region. The remainder of this report centers on the research conducted by the principal investigator on the millimicroplastic burst behavior of zinc monocrystals (1) and on initial dislocation multiplication in shock loaded copper single crystals (2) during the specified grant period. Author (TAB)

N68-30754# Saarland Univ., Saarbrucken (West Germany). Inst. for Metal Physics and Metallurgy.
TENSILE PROPERTIES OF NEARLY INTERSTITIAL-FREE SUBSTITUTIONAL IRON ALLOYS Technical Report, 1 Sep. 1962–31 Dec. 1966
W. Dickenscheid Wright-Patterson AFB, Ohio AFSC Mater. Lab. Feb. 1968 92 p refs
(Contract AF 61(052)-632)
(AFML-TR-68-18; AD-670208)

The report deals with the influence of substituted alloying atoms on the tensile properties and plasticity of iron with very low interstitial content. The specimens - wires of 1 mm diameter were purified in an atmosphere of palladium-filtered high purity hydrogen. Gas analysis showed that interstitial contents were well below the ppm. limit. Tensile properties of the following alloy systems were determined between room temperature and -100C: Fe-Mo, Fe-P, Fe-Si, Fe-Al and Fe-Ni. At sub-zero temperatures Fe-Si alloys showed a decrease of the alloy hardening. Fe-Al and Fe-Ni alloys even displayed alloy softening, i.e. a decrease of the yield stress at increasing alloy concentrations. Phosphorus causes a very strong alloy hardening. Some small part of the phosphorus atoms seems to be in interstitial positions instead of substitutional ones. A method of form analysis was applied to the recorded stress-strain diagrams. Three stages of the deformation process in polycrystalline specimens separated by transition points at about 2% and 7% strain could be traced. The second and third stage resemble some kind of dynamic recovery. The elementary deformation processes seem to take place in an environment of higher dislocation density. Activation volumes that were determined for some alloys correspond to the latter conclusion. Author (TAB)

N68-30758# Atomics International, Canoga Park, Calif.
DIFFUSION BONDING OF TITANIUM ALLOYS Quarterly Report
C. A. Smith and E. C. Supan Watertown, Mass. Army Mater. Res. Agency 1 Oct. 1967 23 p refs
(Contract DA-19-066-AMC-339(X))
(AMRA-CR-66-10/1-5; AI-67-171; QR-5; AD-670078)

Using the alloy Ti-6Al-4V as a reference, the basic mechanisms in the solid state bonding of titanium alloys are being investigated. The following progress was made: Rod and plate stock of Ti-6Al-4V alloy was purchased and received; a supply of halogen-free cutting fluid was obtained. Initial use of this fluid indicates that it is effective in prolonging cutting tool life and reducing machining time; the vacuum hot press was modified to obtain more uniform temperature and bonding pressure; a series of specimens were bonded as part of an effort to better define the effects of time and surface finish on bond strength; a study was initiated to determine the effectiveness of ultrasonic scanning as a means of non-destructive testing of bonded joints; an examination of sample surfaces before and after cleaning was made using optical and electron microscopy. It was found that the cleaning process greatly changes the appearance of the surface. Author (TAB)

N68-30791# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
METAL WORKING AND METAL FORMING TECHNOLOGY
O. J. Wick 22 Apr. 1968 17 p Presented at the Conf. on Technol. Util., Seattle, 25 Apr. 1968
(Contract AT(45-1)-1830)
(BNWL-SA-1806; CONF-680425-2) CFSTI: HC $3.00/MF $0.65

A brief discussion is given of metal working technology developed in the atomic energy program. The developments include glove box techniques, electron beam welding, fabrication of complex shapes using filled billets, a cold drawing lubricant, and adaption of conventional equipment to unconventional jobs. NSA

N68-30800# Battelle Memorial Inst., Columbus, Ohio. Defense Metals Information Center.
RUPTURE STRENGTHS OF SELECTED HIGH-IRON, NICKEL-BASE, COBALT-BASE, AND REFRACTORY METAL ALLOYS
W. F. Simmons 1 May 1968 18 p
(Contract F33615-68-C-1325)
(DMIC-MEMO-236; AD-670153)

Rupture strengths, in graphical form, are presented for selected superalloys at 100 hours and 1000 hours, and for selected refractory metal alloys at 10 hours and 100 hours. Nominal chemical compositions are tabulated for all of the alloys covered. Author (TAB)

N68-30807# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE PROTECTIVE ACTION OF CALCIUM-MAGNESIUM COATING DURING CATHODIC PROTECTION OF STEEL AND IRON IN SEA WATER
Chung-Tao Tai, Ming-tang Chi, and Ching-cheng Ku 20 Sep. 1967 24 p refs Transl. into ENGLISH from Hai Yang Yu Hu Chao (Peking), v. 8, no. 1, 1966 p 51–59
(FTD-HT-67-233; AD-670297)

The protective action of white films formed on iron and steel surfaces in sea water under conditions of cathodic protection was studied. Three series of tests were performed with 16 Mn low-alloy steel. In the first series, specimens were exposed either to natural sea water or to 3% NaCl solution, and protected with a constant current. In the second series the specimens were first exposed to stagnant or stirred sea water and for 3 days protected with a high density, 40 microamp/sq cm, current to form uniform films and then current applied periodically in 24-hr cycles. Specimens of the third series were tested either in natural or artificial sea water with various current densities. The artificial sea water contained either Mg and Ca (pH = 7.7), Mg alone (pH = 7.8), Ca alone (pH = 8.0), or no Mg and Ca (pH = 7.8).

Experimental results showed that protection can be achieved in natural sea water at 25 microamp/sq cm and in 3% NaCl solution at 35 microamp/sq cm. Specimens pretreated with a higher current can be protected at 3.5 microamp/sq cm. The periodically applied current should have a density of 15-20 microamp/sq cm. Polarization of Ca-Mg films is 5-8.8 times that of Ca or Mg films, while polarization of Mg films is higher than that of Ca films. Polarization characteristics are affected by current density applied in forming the film. Film formation is more difficult on rusted metal surfaces and more complete in stirred sea water. Films formed at a pH exceeding 10 provide protection for metals; films formed at pH = 9 fail to protect. TAB

N68-30859# Brown Univ., Providence, R. I.
EXHAUSTION OF DUCTILITY IN COMPRESSED BARS WITH HOLES Progress Report
S. Kobayashi and C. Mylonas Jun. 1968 30 p refs
(Contract Nobs-88294)
(SSC-184; PR-6; AD-670487)

The brittleness of mild steel subjected to tension after prior compressive prestraining has been in part attributed to the collapse of microscopic flaws or voids and to the resulting severe straining, work hardening, and sharpening of the flaw edges. A similar mechanism of embrittlement should operate also with artificial macroscopic flaws such as holes. This was checked with tests of axially compressed bars of ABS-B and of E-steel with transverse pre- or post-drilled single or double holes. The overall nominal compressive prestrain (exhaustion limit) causing brittleness in subsequent tension in bars with pre-drilled holes was about 1/4 the corresponding prestrain for solid bars of E-steel and about 1/2 for ABS-B steel. The possible causes of this difference and the modes of fracture initiation and propagation are discussed. The strong differentiation of steel quality achieved with these tests is very promising for the development of a related acceptance test. Author (TAB)

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N68-29619# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A LABORATORY STUDY OF ANTICORROSIVE EFFECT OF LUBRICANT ADDITIVES [LABORATORNOYE IZUCHENIYE ANTIKORROZIYNOGO DEYSTVIYA PRISADOK K SMAZOCHNYM MASLAM]
A. M. Kuliyev, V. B. Liksha, and F. G. Suleymanova 29 Aug. 1967 8 p refs Transl. into ENGLISH from Azerb. Neft. Khoz. (Baku), v. 43, no. 10, 1964 p 38–40
(FTD-HT-23-902-67; AD-669525)

The anticorrosive action on Pb of alkylphenolic, sulfonated, and antioxidant additives used in various concentrations in Baku and Eastern U.S.S.R. oils was studied during oxidation of the oils at 150C for 25 hrs. The corrosion decreased with an increase of alkylphenol additive concentration. The sulfonated oil additive, SB-3 (Ba salt of sulfonic acids of sulfurized diesel oil), had an anticorrosive action for 15 hrs.; but, after 20-25 hrs., the corrosion was 10-12% higher than that in an oil without additive. The antioxidant additive, DF-11 (Zn dialkyl dithiophosphate) and the antiwear additive, LZ-23K (ethylene diisopropylxanthate) in small amounts (0.5-1.2%) strongly decreased the corrosion. Author (TAB)

N68-29631# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
NEW POLYMERIC MATERIALS IN ANTICORROSION TECHNOLOGY [NOVYYE POLIMERNYYE MATERIALY V ANTIKORROZIONNOI TEKHNIKE]
I. Ya. Klinov 18 Aug. 1967 18 p Transl. into ENGLISH from the book "Trudy Vsesoyuznoy Mezhvuzovskoy Nauchnoy Konferentsii Po Voprosam Bor'by S Korroziyey" Moscow, Gostoptekhizdat, 1962 p 296–303
(FTD-HT-66-540; AD-669518)

The article enumerates several kinds of plastic materials which are suitable for use in combatting corrosion, and several which have suitable strength characteristics as to serve in place of scarce expensive metals and alloys. Included are vinyl for piping, sheet graphite for parts of heat exchangers, liquid Nairit (chloroprene rubber) for anticorrosion protection of ship propellers. Plastics have also been used successfully to fabricate parts of armatures. Plastics of fluorocarbonic compounds have been found especially chemically stable, resisting even fuming nitric acid and aqua regia. Polyorganosiloxanes have proven their value in preventing corrosion. Fiberglass has also found many uses in industrial plant installations. Epoxy resins, epoxy lacquers, nylon and other compounds are also described and examples given of their successful application. Author (TAB)

N68-29701
ON LINEARITY OF THE VISCOELASTIC PROPERTIES OF THE EDF GLASS-PLASTIC (GLASS CLOTH IMPREGNATED WITH EPOXIDE PHENOLIC FORMALDEHYDE RESINS)
P. M. Ogibalov and I. M. Tiuneeva [1968] 5 p refs Transl. into ENGLISH from Vestn. Mosk. Univ., Ser. I: Mat. i Mekhan. (Moscow), no. 1, 1968 p 110–114
CFSTI: HC $3.00/MF $0.65

After a short review of applicable parts of the theory of viscoelasticity and the Boltzmann superposition principle, the experimental conditions are described. Samples were cut at 0°, 45°, and 90° angles to the base from sheet EDF glass fiber material. The sample dimensions were 2.5 mm thickness and 20 mm width. Linearity of the viscoelastic properties was determined by strain measurements on the samples at periodic intervals while they were being kept under loadings for several days. It was found that the material has a domain of linearity in the mechanical properties in the 0° and 90° glass fiber orientation to a stress level of 0.6 kg/mm^2 and in the 45° orientation to a stress level of 0.3 kg/mm^2. Therefore, the linear Boltzmann–Volterra theory of viscoelasticity is applicable in this range for a theoretical determination of stress and strain states of this material. At higher stress levels, the nonlinear theory of viscoelasticity is recommended for this material. K.W.

N68-29712# Princeton Univ., N. J. Frick Chemical Lab.
IONIC CLUSTERS IN HIGH STRENGTH CARBOXYLIC RUBBERS
Arthur V. Tobolsky, Peter F. Lyons, and Noaoki Hata May 1968 26 p refs
(Contract N00014-67-A-0151-0011)
(TR-107; AD-669839)

The viscoelastic effect of ionic linkages in carboxylic rubber is indicative of the presence of hard ionic clusters dispersed throughout an amorphous rubbery matrix. The viscoelastic response characteristics of the metallocarboxylate rubbers are similar to those observed with linear segmented elastomers -- an enhanced and extended rubbery plateau region above a major glass transition temperature. The high strength of the carboxylic rubbers cured with metal oxides is ascribed to the presence of ionic clusters which give rise to a two-phase, reinforced structure. Author (TAB)

N68-29746# Yarsley Research Labs., Ltd. (Gt. Brit.).
VULCANIZATION OF FLUORINE-CONTAINING POLYMERS
A. Nodar-Blanco Jan. 1968 71 p refs
(Contract KS/1/0493/CB-43A2)
(D-MAT-150; AD-669684)

An investigation was carried out into novel systems for the vulcanization of Viton A, in the hope that vulcanizates displaying improved properties at high temperature (especially with regard to compression set) would result. The following systems were studied: (1) p-Xylylene dihalides in conjunction with sodium alkoxides; (2) 4,4-dichloromethyl diphenyl oxide in conjunction with sodium alkoxides; (3) quaternary ammonium compounds; (4) dihydric phenols in conjunction with sodium alkoxides; (5) 4,4dihydroxymethyl diphenyl oxide in conjunction with sodium alkoxides; (6) 4,4-diazidodiphenyl; (7) 4,4-diphenyl bis (diazonium fluoroborate); (8) Pyromellitic dianhydride (dipotassium salt); (9) Dihydrophenazine Systems 1 and 3 were investigated in greatest detail. It was found that quaternary ammonium salts, both bifunctional and monofunctional, are effective vulcanizing agents, the former being the more effective. The preferred vulcanizing system is comprised of a mixture of equal parts of calcium oxide and 1,4-phenylene dimethylene bis (triethyl ammonium chloride). This system gives vulcanizates with compression set at high temperatures superior to those given by dicinnamylidene hexamehtylene diamine. Other mechanical properties and resistance to ageing at 250C in air are similar for vulcanizates prepared with 1,4-phenylene dimethylene bis(triethyl ammonium chloride) and with dicinnamylidene hexamethylene diamine. Author (TAB)

N68-29755# Junta de Energia Nuclear, Madrid (Spain). Division de Metalurgia.
HOT PRESSING OF TALC COMPONENTS [OBTENCION DE ESTEATITA POR PRENSADO EN CALIENTE]
Elias Aparicio Arroyo Apr. 1967 28 p refs In SPANISH; ENGLISH summary
(JEN-190-DMe/1-18) CFSTI: HC $3.00/MF $0.65

Requirements for some special nuclear engineering ceramic shapes are: big size, impervious, dimensional accuracy and good mechanical and dielecric properties. Limitations of the conventional methods and advantages of the hot-pressing techniques for the manufacturing of these shapes are disussed. Hot-pressing characteristics of a certain steatite powder are studied. Occurrence of an optimum densification temperature just above the talc decomposition range is found. Experimental data show that the height/diameter ratio of the specimen has no effect on the sintering conditions. Increasing darkness from the graphite mould is detected above the optimum temperature. The hot-pressed steatite is compared with a fired dry-pressed sample of the same composition. Fabrication pressure and temperature of the hot-pressed body are lower by a factor of 10 and 150°C; the material also exhibits higher mechanical strength and dimensional accuracy, as a consequence of its decreased porosity and shrinkage, with similar dielectric characteristics to those of the conventional steatite. Author (ESRO)

N68-29793 Case Inst. of Tech., Cleveland, Ohio.
MORPHOLOGY OF STRAIN-INDUCED CRYSTALLIZATION OF POLYETHYLENE TEREPHTHALATE
Gregory Soh-uy Yeh (Ph.D. Thesis) 1966 162 p
Available from Univ. Microfilms: HC $7.60/MF $3.00 Order No. 67-11574

A study has been made of the morphology of polyethylene terephthalate (PETP), with primary emphasis on the morphology of the glass and the effect of strain-induced crystallization of the polymer. PETP crystallizes from solution in the form of chain-folded fibrillar ribbons as in most solution-grown polymer crystals. The morphology of the glassy state is characterized by 75Å ball-like structures in which the molecules are packed with some "order". Crystallization from glassy amorphous PETP occurs by the formation of spherulites consisting of ribbon-like lamellae. The long period increases as measured by small angle X-ray scattering with annealing temperature but it decreases with time at a given annealing temperature. An interpretation is given for this decrease of long period with time. Strain-induced crystallization of PETP occurs by alignment of the ball-like structures. Subsequent heat treatment of the strained material produces more complete alignment of the ball-like structures as well as perfection in the chain packing within the structure. Dissert. Abstr.

N68-29907 Oklahoma Univ., Oklahoma City.
VISCOELASTIC BEHAVIOR OF SIMPLE HYDROCARBONS AT HIGH PRESSURE
Robert Gottfried Rein, Jr. (Ph.D. Thesis) 1967 150 p
Available from Univ. Microfilms: HC $7.00/MF $3.00 Order No. 67-11089

The possible viscoelastic behavior of simple hydrocarbons at high pressure was investigated. The viscosity-measuring technique consisted of a torsionally oscillating quartz rod. When the oscillating rod is immersed in a liquid, measurements of the resonant frequency and the resistance of the rod at resonance can be used to calculate the viscous behavior of the liquid. This viscometer reproduced, within experimental accuracy, Newtonian (non-viscoelastic) viscosity versus pressure data obtained by other investigators using different viscosity measuring techniques. When using the torsionally oscillating rod as a high pressure viscometer, the effect of pressure on the resonant frequency of the rod must be considered. This pressure effect on the resonant frequency was measured for 20-kc and 60-kc crystals at pressures up to 8×10^3 atmospheres. Dissert. Abstr.

N68-29997 Ohio State Univ., Columbus.
THE INFLUENCE OF AMBIENT ATMOSPHERES IN MATURATION OF STRUCTURAL CERAMICS
George Oliver Harrell (Ph.D. Thesis) 1967 174 p
Available from Univ. Microfilms: HC $8.00/MF $3.00 Order No. 67-10898

Maturing studies of five representative structural clay materials were conducted from 1700°F. to 2050°F. with 16 flowing gas atmospheres. Atmospheres ranged from highly oxidizing to highly reducing, and included variable water vapor concentrations. Shrinkage and water absorption were used as a measure of maturation, and color differences were noted. Densification increased as the oxygen content of the gases was lowered from 20% to 1%. The corresponding decreases in absorption were 2–3%. No apparent color differences were noted. Reducing atmospheres induced much greater densification than air, with maximum absorption changes ranging from 4.1% to 7.1%. Red colors were produced with reducing atmospheres in some cases. Water vapor in the combustion atmospheres increased densification as compared to dry atmospheres. Excess water vapor enhanced maturation with oxidizing atmospheres and decreased densification with a reducing atmosphere. Dissert. Abstr.

N68-30035 Colorado Univ., Boulder.
1: A STUDY OF CROSSLINKED POLYVINYL ALCOHOL GELS. A: ELASTIC PROPERTIES AND NETWORK TOPOLOGY. B: STRAIN BIREFRINGENCE AND AN INTRINSIC BREWSTER COEFFICIENT. 2: DEPOLARIZATION OF TRANSMITTED LIGHT BY BIREFRINGENT POLYMERIC MATERIALS
John Francis Jackson (Ph.D. Thesis) 1966 99 p
Available from Univ. Microfilms: HC $5.00/MF $3.00 Order No. 67-9989

A rotational shear device for the measurement of static modulus and strain birefringence of polymer gels was constructed. Measurements were made using polyvinyl alcohol-water gels cross-linked by reaction with terephthal-aldehyde. Stress-strain

relations showed Hookean behavior in all cases. We investigated the relationship of modulus to gel concentration, primary molecular weight and crosslink density. A topological correction factor is proposed to explain the deviation of modulus from the classical theory. Measurements of the stress-optical coefficient of polyvinyl alcohol-water gels were made. Optical retardation increases linearly with strain; that is, the stress-optical coefficient is independent of elongation. It increases with increasing crosslink density and decreases with increasing polymer concentration. A theory is proposed to explain the depolarization of light passing through strained birefringent materials. The effect arises from differences in birefringence of microscopic sections of the strained material. Dissert. Abstr.

N68-30069 Pennsylvania State Univ., University Park.
THE MEASUREMENT AND CORRELATION OF SOME PHYSICAL PROPERTIES OF METHANE AND PER-DEUTEROMETHANE
Anthony Frederick Grigor (Ph.D. Thesis) 1968 150 p
Available from Univ. Microfilms: HC $7.00/MF $3.00 Order No. 67-11189

The physical properties of CH_4 and CD_4 were measured from their melting points (ca. 90°K) to their critical temperature (ca. 190°K). The data were treated in terms of the quantum modification of the theorem of corresponding states. Measured were the densities, vapor pressures, isothermal compressibilities for CH_4 and CD_4 and the critical constants for CD_4. The changes in molecular volumes and in the vapor pressures were compared with the predictions of the theorem of corresponding states. The experimental changes in molar volume agreed well with calculations based on the quantum modification of the theorem of corresponding states. Although the correlation of the molar volumes to theory was good, the correlation of the vapor pressure was only fair because of the uncertainty in the fundamental vibrational frequencies of CH_4 and CD_4 gas and liquid which were necessary in the determination of the vibrational quantum effect. Dissert. Abstr.

N68-30345# Union Carbide Corp., Oak Ridge, Tenn. Nuclear Div. Y-12 Plant.
ANISOTROPIC PHOTOELASTIC ANALYSIS OF FIBER REINFORCED COMPOSITE MATERIALS
Charles Eugene Knight, Jr. 19 Mar. 1968 82 p refs
(Contract W-7405-ENG-26)
(Y-1609) CFSTI: HC $3.00/MF $0.65

A theoretical and experimental investigation was made of the photoelastic effect in a transparent anisotropic material. The material is a fiber glass reinforced epoxy resin, and vacuum impregnation techniques were developed to render the material transparent. Isochromatics and isoclinics in the material when subjected to both uniaxial and biaxial stresses were observed and compared to the predicted data. Isochromatic data proved to be representable by an orthotropic stress-optic law. Isoclinics were predictable...but at a given point in a stressed model the isoclinic angle depends on both the angle of principal stress directions and the ratio of principal stress magnitudes. Thus, the isoclinics do not directly give the principal stress directions. At this point, the anisotropic photoelasticity solution cannot be determined. Author (NSA)

N68-30352*# Techtran Corp., Glen Burnie, Md.
DEGRADATION AND THERMAL AGING OF POLYCHLOROPHENE RUBBER [ISSLEDOVANIYE PROTSESSA DESTRUKTSII I TEPLOVOGO STARENIYA POLIKHLOROPRENOVOGO KAUCHUKA (NAIRIT)]
N. M. Kocharyan, N. A. Nalbandyan, V. Ts. Arakelyan, and G. S. Farshyan Washington NASA Jul. 1968 5 p refs Transl. into ENGLISH from Dokl. Akad. Nauk Arm. SSR (Everan), v. 36, no. 2, 1963 p 83–87
(Contract NASw-1695)
(NASA-TT-F-11801) CSCL 11J

The dependence of the degree of degradation of a polychlorophene rubber solution in benzene on ultrasonic frequency and heat degradation at rather low temperatures are investigated. The experimental apparatus and conditions are described. The molecular weight of the polymer is reduced to some constant value depending on the frequencies and power of ultrasonic emission. The greatest degree of degradation occurs on a frequency of 800 KHz. Author

N68-30373# Ordnance Research, Inc., Fort Walton Beach, Fla.
STUDY OF VISUAL CAST FLARE BINDER MATERIAL
Final Report, 13 Sep.–18 Nov. 1967
Hal R. Waite and Yoshiyuki Arikawa Jan. 1968 28 p
(Contract N00164-67-C-0479)
(RDTR-113; AD-669434)

Castable visual flare formulations and techniques were developed that produce luminous efficiencies greater than 50,000 candle-seconds/gram. Improved luminous efficiencies and ease of casting were made possible with a relatively high binder percentage of sixteen percent. No pressure is required for casting. Liquid polyester binder systems were found to provide optimum characteristics for casting as well as luminous efficiency with their high oxygen and low carbon content. Optimum sodium perchlorate oxidizer to magnesium fuel ratio was determined to be one to one with oxidizer partially dissolved in liquid binder. Flare grains in sizes from 3.2 inches to 4 inches in diameter were cast and tested with no significant change in efficiency versus diameter. Author (TAB)

N68-30444# Naval Research Lab., Washington, D. C.
FILAMENT-WINDING PLASTICS. PART 5: EPOXY-AMINE REACTIONS AND THE PRACTICAL USE OF HIGH-STRENGTH PLASTICS
James R. Griffith and Mary E. McGraw 10 Apr. 1968 19 p refs
(NRL-6690; AD-670483)

The plastics formed when epoxy resins react with polyfunctional amines have extremely complex molecular structures. Except for the basic reactions of simple epoxies, little is known regarding the molecular structures of such materials. Hence probable structures for certain molecular regions of the cured plastics must be deduced from known structures of simple analogs. In this work some relatively simple epoxy-amine systems were studied to obtain information regarding isomers, reaction sequences, and rates which are likely to prevail in complex polymerizations. The major reaction process of coreacting amines is an additive coupling. Gas chromatography and nuclear magnetic resonance were used to determine which of some possible isomers were formed in the reactions studied. Aromatic amines are not as reactive as aliphatic amines at moderate temperatures. Reaction rate and reaction temperature affect the properties of the resulting plastic. Proper conditions allow the production of a partially polymerized resin syrup of high-strength epoxies with reduced monomer content. When MABA is used as a curing agent, the reactions can be stopped when a suitable viscosity is reached for wet winding or preimpregnation of the reinforcement fibers. Author (TAB)

N68-30482# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CTM, A NEW AND EFFECTIVE STABILIZER FOR SILICONE LUBRICANTS [TSTM-NOVYI EFFEKTIVNYI STABILIZATOR DLYA SILIKONOVYKH SMAZO CHNYKH MATERIALOV]
R. I. Kobzova, G. S. Tubyanskaya, E. M. Oparina, V. A. Zaitsev, and A. A. Egorova 31 Aug. 1967 7 p refs Transl. into ENGLISH from Khim. Tekhnol. Toplin Masel, no. 4, 1966 p 47–48
(FTD-HT-67-226; AD-670101)

The high effectiveness of cyclopentadiene tricarbonyl manganese as a stabilizer for PMS-100 silicone fluid has been demonstrated. The dependence of its effectiveness on its concentration has been investigated. The curve of this dependence at

250C was shown to pass through a maximum. It was established that the optimum concentration of CTM depends on the temperature at which the silicone fluid is used. Author (TAB)

N68-30522# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SYNERGISM OF ANTIOXIDANTS IN SYNTHETIC ESSENTIAL OIL [O SINERGIZME ANTIOKSIDANTOV V SINTETICHESKOM EFIRNOM MASLE]
Ya. M. Slobodin and A. A. Gonor 1 Sep. 1967 11 p refs Transl. into ENGLISH from Khim. i Tekhnol. Topliv i Masel (Moscow), no. 3, 1966, p 48–51
(FTD-HT-67-228; AD-670066)

The synergistic effect of antioxidant mixtures in synthetic ester lubricating oils was studied. It is noted that ester oils are used as lubricants at elevated temperatures and therefore require effective inhibitors. The ester oil used was an ester of pentaerythritol and C5-C9 monocarboxylic acids. Mixtures of the three phenolic inhibitors, 2,6-di-tert-butyl-4-methylphenol (Ionol), 4,4-methylenebis (2,6-di-tert-butylphenol) (designated MB-1 in the source), and 2,2-methylenebis (4-methyl-6-tert-butylphenol) (22-46 in the source) between themselves, and mixtures of each of them with (p-hydroxyphenyl) phenylamine (ODFA) and diphenylamine (DFA) were tested in various concentrations. The criterion of antioxidant effectiveness was the induction period in tests involving oxidation of the oil with oxygen at 160C. Test results are given in tabular and graphic form. It was found that inhibitor action was governed both by the chemical structure of the inhibitors and by their relative proportion in the inhibitor mixture. A synergistic effect was exhibited by all mixtures of the phenols with diphenylamine, mixtures of MB-1 with Ionol, and a mixture of ODFA with 22-46 containing >35 mol% ODFA. An antagonistic effect was also observed in certain cases. Author (TAB)

N68-30534# Explosives Research and Development Establishment, Waltham Abbey (England).
MODEL POLYETHERS. 5: SOME PHYSICAL PROPERTIES
T. P. Hobin 3 Jan. 1968 15 p refs
(ERDE-26/R/67; AD-670420)

Melting points, dielectric constants and surface tensions of model polyethers H((CH2)yO)x(CH2)yH were measured, where y = 4, 5, 6 and 10 and x = 2, 3 and 4. These, and previously reported values of densities and refractive indices are discussed in terms of molecular structure. Some of the physical properties of the corresponding high polymers were estimated. Author (TAB)

N68-30565# Army Weapons Command, Rock Island, Ill. Research and Engineering Div.
COMPARISON OF STATIC AND DYNAMIC OXIDATION OF GREASE
Carol J. Linch Apr. 1968 33 p refs
(RIA-68-897; AD-670019)

Noninhibited and inhibited soap thickened greases were oxidized statically and dynamically to determine the wear-causing oxidation products formed by both methods and to determine if a standard dynamic oxidation test could be established. The effect of both types of oxidation on grease properties such as penetration, neutralization number, evaporation and lubricity were determined. The following conclusions can be drawn from the investigation: (1) Although the induction period was longer, the total amount of oxygen absorbed at the conclusion was greater for the dynamic oxidation test than for the static test. (2) Volatile and nonvolatile oxidation products were formed that affected the lubricity of the grease. (3) The lubricity properties of the dynamically oxidized greases were less affected even though they were oxidized to a greater extent than in the static test. This indicates the possibility that the mechanism of oxidation is different for the two types of tests. (4) Metallic particles introduced into the grease during dynamic oxidation may account for the difference in the oxidation mechanism. (5) Further work should be done to determine the difference in the oxidation mechanism. Author (TAB)

N68-30597*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
POLYMER-FILM COATING OF MAGNESIUM FOR PARABOLOIDAL MIRRORS
Thaddeus S. Mroz and Robert B. King Washington Aug. 1968 13 p refs
(NASA-TN-D-4734) CFSTI: HC$3.00/MF$0.65 CSCL 11C

A material and a method were determined for coating large mechanically polished magnesium surfaces to provide a high quality surface, acceptable for further coating with vapor-deposited optical films. The coating material was a modified epoxy resin mixture. The application procedure consisted of surface preparation using commercially available chemical cleaning agents, spray application with commercially available equipment, and a carefully programmed curing schedule. Author

N68-30763# Bhabha Atomic Research Centre, Bombay (India). Chemistry Div.
COMPATIBILITY STUDIES ON VINYL PAINT
S. B. Srivastava, K. V. S. Rama Rao, L. V. Shastry, and A. S. Sarpotdar 1967 8 p refs
(BARC-322) CFSTI: HC$3.00/MF$0.65

Vinyl paints have been recommended for lining the steel tanks which will be used for storage of heavy water at Rana Pratap Sagar Atomic Power Project. This report examines four aspects of its compatibility, viz.: (1) isotopic exchange between heavy water and painted surface, (2) change in pD of heavy water after a prolonged period of storage (3), formation of hydrogen chloride during storage and finally (4) effect of nuclear radiation when such stored heavy water samples are used in reactor as moderator. Author

N68-30771# Puerto Rico Nuclear Center, San Juan. Physical Sciences Div.
RADIATION CHEMISTRY OF ORGANIC GLASSES
Alec Grimison [1968] 13 p refs Presented at the 2d Inter-Am. Conf. on Radiochem., Mexico City
(Contract AT(40-1)-1833)
(CONF-68D423-1) CFSTI: HC$3.00/MF$0.65

Some of the important considerations in the radiation chemistry of low-temperature organic glasses are reviewed, and some specific results obtained at the Puerto Rico Nuclear Center are presented. The main emphasis is on the matrix isolation technique. The major work at PRNC has centered around the use of two particular glassy matrices for the spectrophotometric identification of gamma-radiolytic intermediates from simple heterocyclic molecules. These are 2-methyltetrahydrofuran (MTHF) and a mixture of two commercial Freons (FM). It was concluded that the matrix isolation method provides a very effective way of studying the intermediates produced by gamma radiolysis. NSA

N68-30816 College of Aeronautics, Cranfield (England). Dept. of Materials.
THE EFFECT OF CURING CONDITIONS ON THE EXTENT OF CURE OF POLYESTER RESIN CRYSTIC 189 (SCOT–BADER LTD.)
D. A. Smith Jun. 1968 15 p refs
(COA-NOTE-MAT-20) CFSTI: $3.00

The cross-linking, or cure, of polyester resin crystic 189 was investigated by examining the resin during cure by means of acetone extractions and hardness tests. The experiments were designed to test Funke's hypothesis that in the cure of polyester resins the nature of the final network is predetermined by conditions before the gel point, and that post-gel conditions affect the rate

of cure but not the nature of the final network and the final degree of conversion. Funke's work was based on analysis of the final products of hydrolytic degradation of polyesters which is quite different from the methods used in this investigation. It was concluded that the evidence did not support Funke's hypothesis and explanations are afforded for this and suggestions for future work are recorded. Author

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers.

N68-29569# Stanford Univ., Calif. Statistics Dept.
ON CHARACTERIZATION OF THE GAMMA DISTRIBUTION
W. J. Hall and Gordon Simons 1 May 1968 15 p refs
(Contract Nonr-225(72))
(TR-60; AD-669463)

Let X sub 1, X sub 2,... be a sequence of i.i.d. random variables and S sub n = summation, j = 1 to j = n, of X sub j. If X sub 1 has a gamma distribution, (Z sub n is identically equal to S(subscript n, superscript r)/E(S subscript n, superscript r)); n = or > 1) is a reverse martingale sequence for any positive r. These reverse martingales find applications in sequential analysis. In this paper the converse is proved for any integer r > 1, and this provides a characterization of the gamma distribution; in fact, it is sufficient that the reverse martingale sequence have finite length r. Another characterization is also proved, extending the case r = 2 to non-identically distributed r.v.s. Author (TAB)

N68-29584 Brown Univ., Providence, R. I.
DIFFERENTIAL GEOMETRY OF COMPLEX HYPERSURFACES
Brian Brendan Smyth (Ph. D. Thesis) 1966 39 p
Available from Univ. Microfilms: HC $3.00/MF $0.65 Order No. 67-2291

Let M be a complex analytic submanifold (of complex dimension $n \geq 2$) of $\bar{M}$, where $\bar{M}$ is any one of the complex space forms $P^{n+1}(C)$ (Fubini-Study metric), C^{n+1} (complex Euclidean metric), D^{n+1} (Bergman metric). M is a Kähler manifold in the metric induced from $\bar{M}$ and all metric properties refer to this metric. When M is Einstein, the Ricci tensor S equals ρ g, where g is the metric on M induced from $\bar{M}$ and ρ is some constant. Theorem: If M is Einstein it is locally symmetric. If $\bar{M} = P^{n+1}(C)$ and M is a complete Einstein manifold, then M is either $P^n(C)$ or the complex quadric Q^n. If $\bar{M} = D^{n+1}$ (resp. C^{n+1}) and M is a simply-connected complete Einstein manifold, then M is D^n (resp. C^n). If M is complete and Einstein with $\rho > 0$, then by the theorems of Myers and Kobayashi M is compact and simply connected. This accounts for best results being obtained when M = $P^{n+1}(C)$. The restricted holonomy group of M is computed for all posible ρ and used together with Cartan's list of irreducible Hermitian symmetric spaces to obtain the classification in the above theorem. Dissert. Abstr.

N68-29650# European Space Vehicle Launcher Development Organization, Paris (France). Studies and Experimental Work Directorate.
COMPUTATIONAL ARTIFICES IN A RECURSIVE DATA-ELABORATION TECHNIQUE
E. Cambi May 1968 41 p refs
(ELDO-TM-111) CFSTI: HC $3.00/MF $0.65

A number of artifices are presented and discussed, which are expected to allow an interesting reduction in the computing time in those cases where the order of the differential system is fairly high: for example, when a relatively large number of measurements are taken and an autocorrelation is reasonably expected to exist between successive readings of the same quantity. If the rate at which readings are available is fairly rapid, as is the case of the Gove station, reducing the computing time can make a larger number of measurements exploitable, thus obviously improving the accuracy. Author (ESRO)

N68-29653# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
BASIS OF THE THEORY OF TWO-PLAYER QUALITATIVE GAMES, PART 1 [BASES DE LA THEORIE DES JEUX QUALITATIFS A DEUX JOUEURS; PREMIERE PARTIE]
Apr. 1968 59 p refs In FRENCH; ENGLISH summary
(CEA-R-3475(1)) CFSTI: HC $3.00/MF $0.65

A class of two-player games is discussed. Players can influence the motion of the state of the game by choosing strategies in given sets. In two target games, each player strives to reach his own target; in single-target games, one of the players strives to reach the target while his opponent tries to avoid this event. In the state space, the boundaries are defined which have impenetrability properties for one or the other player. The time history of the state depends on the position of the initial state with respect to these sets. The concept of pure strategy is defined. A geometrical approach of the properties of the boundaries of these sets results in a Min-max theorem for boundary paths. The special case of autonomous differential games with time independent targets is studied. Author (ESRO)

N68-29761 Minnesota Univ., Minneapolis.
CONSTRUCTIVE METHODS FOR THE CONFORMAL MAPPING OF DOMAINS WITH CORNERS
Glenn E. Schrober (Ph.D. Thesis) 1965 70 p
Available from Univ. Microfilms: HC $3.80/MF $3.00 Order No. 67-9637

An iterative technique is presented for constructing the conformal map onto the unit disk from a domain whose boundary is a Jordan curve with corners. An integral equation (essentially due to Arbenz and related to Gershgorin's integral equation) involving simple geometric quantities is used to define iterations for a curve C of bounded rotation without cusps. The iterations are shown to converge uniformly. If C has a bounded arc length-chord length ratio, then in terms of that bound a simple explicit lower bound, strictly greater than one, is given for λ_2. This leads to limit theorems concerning the eigenvalues for curves approaching a fixed curve. Also essential to the analysis and of independent interest are bounds for the p^{th} mean of the derivative of the mapping function on C. The importance of the bounds is that they depend only on certain parameters of the curve C and are therefore useful when one desires uniform bounds for a family of curves. Dissert. Abstr.

N68-29766 California Univ., Berkeley.
SENSITIVITY ANALYSIS AND OPTIMUM SYNTHESIS OF TRANSFER FUNCTIONS
Ranendra Narayan Biswas (Ph.D. Thesis) 1967 128 p
Available from Univ. Microfilms: HC $6.20/MF $3.00 Order No. 67-11596

In this dissertation, the multiparameter sensitivity problem is formulated in terms of vector flow graph. The properties of vector flow graphs are studied to that end, and exploited for the synthesis of transfer functions with minimum sensitivity to parameter perturbations. An expansion formula for the transfer matrix of any vector flow graph in terms of its branch matrices is developed by generalizing the concepts of forward transmission and loop transmission to multiloop, multivariable systems. The expansion is obtained by repeated application of a simple relationship between the transfer matrix of any vector flow graph and the transfer matrices of its subgraphs. By means of a single-loop, two-node vector flow graph representation of linear systems sensitivity matrices are

defined in the frequency domain for general linear time-invariant systems. Relationships of the sensitivity coefficients with the elements of sensitivity matrices, as also with the elements of the transfer matrix, are derived and utilized to construct a model for the measurement of the sensitivity coefficients. Dissert. Abstr.

N68-29780
ON A MATRIX ALGORITHM FOR THE SOLUTION OF LINEAR DIFFERENTIAL EQUATIONS AND THEIR SYSTEMS
Iu. I. Borshch 1968 8 p refs Transl. into ENGLISH from Zh. Vychisl. Mat. i Mat. Fiz. (USSR), v. 7, no. 6, 1968 p 1385–1395
CFSTI: HC $3.00/MF $0.65

Detailed mathematical models are presented for a matrix algorithm for solving linear differential equations and their systems, and the matrix relations are in the Cauchy form or the method of initial parameters. A method is included for discretizing the remainder time that eliminates to a considerable extent the disadvantages of the conventional integral matrix method used in such computations. The linear matrix equation is obtained with a triangular matrix (T) whose inversion consists in the direct evaluation of the coefficients of T^{-1} by simple recursion formulas. The described scheme for solving the linear differential equations corresponds to the application of a k-th order matrix method; and, as compared with the accuracy of the solution of the equation ($p > k$), will naturally raise the accuracy of the solution without increasing the number of nodes. Examples of using the method are included. M.W.R.

N68-29791 Pittsburgh Univ., Pa.
TOPOLOGICAL AND SPECTRAL PROPERTIES OF THE SET OF LINEAR OPERATORS IN A BANACH SPACE
Nicholas John Bezak (Ph.D. Thesis) 1967 94 p
Available from Univ. Microfilms: HC $4.80/MF $3.00 Order No. 67-12586

Let X and Y be non-trivial real or complex Banach spaces. Let T be the set of linear operators T defined on domains in X and having ranges in Y. This thesis is mainly devoted to investigating convergence of operators in T and continuity properties of their spectra with respect to the topology determined by the Gokhburg and Markus distance. Using this topology the following classical results are generalized. The inverse mapping is proved to be continuous on its domain and the conjugate mapping assigning to an operator its conjugate, is proved continuous. Dissert. Abstr.

N68-29817# California Univ., Los Angeles. Dept. of Mathematics.
THE CLASS OF K-FUNCTIONS ON RIEMANNIAN SPACES
Samuel G. Councilman Apr. 1968 83 p refs
(Grant DA-ARO(D)-31-124-G855)
(AROD-6929.16-M; TR-44; AD-669260)

The class of harmonic functions on a Riemannian n-space which have vanishing flux across all dividing (n-1)-cycles is considered. The tools employed are normal operators, principal functions, and the Main Existence Theorem, all introduced in earlier work of L. Sario. The results constitute an extension to general Riemannian spaces, of arbitrary dimension $N = \text{or} > 2$, of properties known for such a class of functions on a Riemann surface. Author (TAB)

N68-29818# Picatinny Arsenal, Dover, N. J. Engineering Sciences Lab.
IGRAPH—A PROGRAM FOR ISOMETRIC PLOTTING
James H. Fahs Feb. 1968 40 p refs
(PA-TR-3679; AD-669605)

A description is given of a set of FORTRAN subroutines which will plot, in isometric projection, a surface defined by two independent variables. The six subroutines, collectively known as IGRAPH, are called by the users main program and in turn call upon the library routines prepared for the CALCOMP plotter. Sufficient instructions are given to allow the IGRAPH routines to be used, along with examples of plots prepared by these routines. For those desiring more details the basic operation of each routine is described and listings are included. Author (TAB)

N68-29824# Minorsky (Nicholas) Demaine de l'Arc, Aix-en-Provence (France).
INVESTIGATION OF NONLINEAR CONTROL SYSTEMS. PART 8: OSCILLATIONS IN CONTROL SYSTEMS
Nicholas Minorsky Washington ONR Apr. 1967 215 p refs
(Contract N62558-4544)
(AD-669523)

This report is devoted to the general survey of methods dealing with oscillations in control systems. Chapter headings include Outline of the classical theory; Stroboscopic method; Piece-wise linear idealization; Piece-wise linear theory and Programming control. The work is Part 8 of a general investigation of Nonlinear Control Systems. TAB

N68-29875 Oklahoma Univ., Oklahoma City.
SYNTHESIS OF OPTIMUM LINEAR MULTIVARIABLE SYSTEMS
Sayyed Mohammad Mofeez (Ph.D. Thesis) 1967 127 p
Available from Univ. Microfilms: HC $6.20/MF $3.00 Order No. 67-12001

Analytical synthesis methods for design of optimum, linear, constant coefficient, multivariable systems are developed. Matrix methods are used to extend the well-known concepts in single variable systems to the case of systems with multiple inputs and outputs. The performance criterion used is the minimized sum of weighted mean-square errors between the set of actual outputs and a set of ideal or designed outputs. Standard variational procedure is used to show that optimization of linear, multivariable systems leads to a set of simultaneous Wiener–Hopf equations. The derivation of this set has been achieved in two different ways. In one method derivation is performed strictly in the time domain. The alternative method is used to show the advantage of working strictly in the frequency domain. The resulting vector Wiener–Hopf equation is then properly modified and is solved by a method which is a combination of the "functional method" and the method of undetermined coefficients. Dissert. Abstr.

N68-29917 Kansas Univ., Kansas City.
GENERATION OF RANDOM NUMBERS FROM NATURAL FLUCTUATION PHENOMENA
Herschell Frederick Murry (Ph.D. Thesis) 1966 154 p
Available from Univ. Microfilms: HC $7.20/MF $3.00 Order No. 67-10828

Applications of random numbers are presented, the different ways of obtaining random numbers are compared, and the literature on random number generation is surveyed. It is shown that working in the binary number system provides many advantages at no loss in generality. Conclusions concerning the power spectrum, bandwidth, and amplitude probability distribution of the natural random process are made, and a maximum sampling rate and bias point of a binary quantizer for converting the random analog signal into digital form are derived. An inhibit gate and storage element are shown to be necessary in order to prevent state changes during the sampling instant. Suggestions are given for protecting a practical random number generator from interference and probability bias. Dissert. Abstr.

N68-29935 Pennsylvania Univ., Philadelphia.
IDENTIFICATION OF NONLINEAR SYSTEMS USING FUNCTIONAL POLYNOMIALS AND STOCHASTIC APPROXIMATION
Harry G. Kwatny (Ph.D. Thesis) 1967 181 p
Available from Univ. Microfilms: HC $8.40/MF $3.00 Order No. 67-12768

This study is concerned with the identification of a class of single-input single-output nonlinear systems which can be represented by a functional power series. A method is proposed which is based on an adaptive model whose coefficients are automatically adjusted to minimize a specified error criterion using a stochastic approximation. Either a mean square error or a modified mean square error criterion is chosen as a success criterion. The process is shown to converge under conditions generally satisfied in practical situations. The parameter adjustment procedures are computationally simple and have asymptotic properties insensitive to independent random disturbances. A mathematical analysis of the convergence behavior of the parameter adjustment procedure and an estimate of the rate of asymptotic convergence are given. A class of system time variations is included in the analysis. The identification process is shown to converge even when the system input and noise statistics are time dependent. Computer simulations of three identification problems are included. Little a priori knowledge about the system or the input is required in order to have a successful application. The method is suitable for online applications. Dissert. Abstr.

N68-29964 Pennsylvania Univ., Philadelphia.
THE PRODUCT OF IMPLICATION AND COUNTER-IMPLICATION
Rangaswamy V. Setlur (Ph.D. Thesis) 1967 88 p
Available from Univ. Microfilms: HC $4.60/MF $3.00 Order No. 67-12803

The main result of this dissertation is that the logic system based on the single binary connective O that is the product connective of implication (C) and counter-implication (Ↄ) is finitely axiomatizable. Two complete axiomatizations of the O-system have been developed. One of the important auxiliary steps in the development of the first axiomatization is the derivation of a complete axiomatization of the Ↄ-system by the translation of the axiom and the rules of inference of Łukasiewicz's complete axiomatization of the C-system consisting of the single axiom Ł: CCCpqrCCrpCsp, and the two rules of inference—the rule of substitution and the rule of detachment for C, viz., $C\alpha\beta$, $\alpha \rightarrow \beta$. Dissert. Abstr.

N68-29974 Maryland Univ., College Park.
CONTRIBUTIONS TO PERTURBATION THEORY FOR LINEAR OPERATORS WITH CLOSED RANGE
Richard Kelly Oliver (Ph.D. Thesis) 1967 55 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-11318

In a 1958 paper on perturbation theory Kato introduced a certain function γ, which he called the lower bound, defined for any closed linear operator and taking values in $[0,\infty]$, and demonstrated its importance in perturbation theory by showing that if T is a semi-Fredholm operator from a Banach space X to a Banach space Y, i.e., a closed linear operator T with domain in X and range in Y such that the range of T is closed and one of $\alpha(T)$, $\beta(T)$ is finite, where α denotes dimension of kernel and β denotes codimension of range, and L_T is the set of all bounded linear operators with domain in X and range in Y whose domain contains that of T, then $B \in L_T$ and $\|B\| < \gamma(T)$ implies T + B is semi-Fredholm, $\alpha(T + B) \leq \alpha(T)$, and $\beta(T + B) \leq \beta(T)$, and that γ is, in a certain sense, the best function for which the preceding is true. This thesis is devoted mainly to a study of certain properties of the function γ. Our main result concerns (essentially) the continuity of γ relative to a certain topology on the set $U_c(X,Y)$ of closed linear operators with domain in the Banach space X and range in the Banach space Y, which coincides on the set L(X,Y) of everywhere defined bounded linear operators from X to Y with the operator norm topology. We show that γ is upper semi-continuous of all $U_c(X,Y)$ and continuous on the set N_k (resp. M_k) of all T in $U_c(X,Y)$ with closed range and $\alpha(T) = k$ (resp. $\beta(T) = k$) for each non-negative integer k. Dissert. Abstr.

N68-29981# Commissariat a l'Energie Atomique, Limel (France).
INSTABILITIES IN NUMERICAL SOLUTIONS TO FREDHOLM AND VOLTERRA INTEGRAL EQUATIONS OF THE FIRST KIND. RESOLUTION BY TCHEBYCHEFF POLYNOMIALS. APPLICATION TO PHOTONUCLEAR CROSS-SECTIONS [INSTABILITES DES SOLUTIONS NUMERIQUES D'EQUATIONS INTEGRALES DE FREDHOLM ET VOLTERRA DE PREMIERE ESPECE. RESOLUTION PAR LES POLYNOYES DE TCHEBYCHEFF. APPLICATION AUX SECTIONS EFFICACES PHOTONUCLEAIRES]
Yves Moriceau Mar. 1968 50 p refs In FRENCH; ENGLISH summary
(CEA-R-3427) CFSTI: HC $3.00/MF $0.65

Photo cross section curves depend on numerical resolution as well as on other solutions to integral equations of the first kind if they are oscillating. A typical example showing the growth of the oscillations is presented. In addition, a new method is explained which yields a smooth resolution. From experimental data on equi-distant intervals, functions are constructed and expanded into Chebyshev polynomials. It is pointed out that semi-analytical solutions to this type of problem are illusive. Author (ESRO)

N68-30015# California Univ., Berkeley. Structural Engineering Lab.
STABILITY OF SOME NONLINEAR SYSTEMS Interim Technical Report
Naser Mostaghel and Jerome L. Sackman Feb. 1968 75 p refs
(Contract DA-31-124-ARO(D)-460)
(Rept.-68-2; AD-669630)

The stability of systems governed by x double dot + f(x) + q(x, x dot)x dot - phi(t) r(x) = S(x;t) is studied. Liapunovs Direct Method and a linearization approach have been used in the study of stability of the above system for phi(t) L sub 1 integrable, and periodic, respectively. In the former case a sufficiency region of stability is constructed through the use of a Liapunov function. In the latter case, which is investigated by means of a linearization process, a Hill equation is obtained, whose stability is studied by a method suggested by Malkin. Malkins method is then modified to obtain, by use of a first approximation, the first stability region in parameter space. A second approximation is also worked out. When the approximations obtained herein for general periodic function are reduced to the special cases of the Mathieu equation and the Hill-3-term equation, the results compare very well with the available numerical results based on the exact solution of each of those equations. Author (TAB)

N68-30016# Massachusetts Inst. of Tech., Cambridge. Operations Research Center.
MULTI-QUEUES WITH CHANGEOVER TIMES
Martin Eisenberg (Ph.D. Thesis) Apr. 1968 145 p refs
(Contracts DA-31-124-ARO(D)-209; Nonr-3963(06))
(TR-35; AROD-968.50-M; AD-669628)

The problem of a queuing system with changeover times is studied to determine the effect of the queue discipline. Several specific disciplines for the two-line case are investigated and compared. The alternating priority and strict priority disciplines are investigated for the general two-line system. A class of disciplines are analyzed for the two-line system with zero changeover times. For alternating priority, the mean waiting times are obtained and it is shown how higher moments may be derived. For each of the other disciplines, explicit expressions for the Laplace-Steiltjes transforms of the waiting time distributions are obtained and the means of these distributions are computed. The non-saturation condition and several other measures of performance are found in each case. The technique used throughout is the application of generating functions to the imbedded process formed at the instants of service-completion. In an appendix the mean waiting time of an arbitrary customer is obtained for a specialized K-line system. The

mean waiting times for various disciplines are compared for a specific system. It is observed that disciplines which increase the idle time do not necessarily decrease the waiting time, and in fact, might cause the waiting time to increase. It is shown that disciplines which are potentially optimum can be classified in a general way. The specific disciplines studied are found to fall into this classification.
Author (TAB)

N68-30026# California Univ., Berkeley. Center for Research in Management Science.
FIRST-ORDER CERTAINTY EQUIVALENCE
Edmond Malinvaud Apr. 1968 26 p refs Sponsored in part by NSF
(Contract Nonr-222(77))
(TR-27; AD-669465)

Given any problem of decision under risk to which the expected utility hypothesis applies, one may associate to it first a riskless problem in which random disturbances are replaced by their expected values, and second a class of intermediate risky problems with decreasing degrees of uncertainty. In this class the optimal decision depends in principle on the degree of uncertainty but turns out to be independent of it, to the first order of approximation, in the neighborhood of the riskless problem. The first-order certainty equivalence explains why it is so difficult to characterize the situations in which an increase in the degree of uncertainty requires a decrease in the allocation of resources to the risky projects.
Author (TAB)

N68-30091# Technische Hogeschool, Eindhoven (Netherlands).
GENERAL GROUP EXTENSIONS
Hendricus Petrus Johannes van de Kerkhog (Ph.D. Thesis) [1968] 92 p refs
CFSTI: HC$3.00/MF$0.65

A set of all non-empty finite strings (words) of elements (letters) is considered, and the free semigroup generated by the elements is the structure. Permutation isomorphism of similar permutation representations, or S-functions, are defined; and near groups and equivalent S-extensions are discussed. A system of two-sided representatives as well as the connection between the S-functions and the transfer are considered; as are Schreier extensions, pure extensions, S-extensions with a group, and Frobenius extensions. A construction is included for an S-extension from a given Schreier extension and a given pure extension; and group products are discussed.
M.W.R.

N68-30094*# Illinois Univ., Urbana. Dept. of Physics.
THE RESTRICTED PROBLEM OF THREE BODIES (3) Final Report
Curtis A. Wagner 1 Jun. 1968 23 p refs
(Grant NsG-280-63)
(NASA-CR-95832; TR-4) CFSTI: HC$3.00/MF$0.65 CSCL 12A

Variations of some limiting asymptotic orbits with mass ratio are considered for the restricted problem of three bodies, and motion under a periodic cubic force was studied. A plot of 14 asymptotic limiting orbits symmetric with respect to the xi-axis are included for Stromgren's case of equal finite masses; and initial and final conditions plus a listing of the classes of periodic solutions associated with each of the limiting orbits are given. Several small classes of solutions were found to begin and end on one of the 14 limiting orbits; and a more extensive class began at one of the masses and terminated on a hybrid combination of two of the asymptotic orbits. This unexpected termination indicated the possibility of an infinite number of periodic-asymptotic hybrid limiting orbits and their associated classes of periodic solutions. A search was not made for 3 and 4-membered hybrid classes, but the number of combinations and permutations possible for multimembered periodic-asymptotic limiting orbits appears to be almost limitless.
M.W.R.

N68-30095
ON APPLICATION OF THE METHOD OF LINES TO DOMAINS OF IRREGULAR SHAPE
Nguen Tam [1968] 10 p refs Transl. into ENGLISH from Vychisl. Mate. i Matem. Fiz. (USSR), v. 8, no. 2, 1968 p 334–343
CFSTI: HC$3.00/MF$0.65

Solution of an elliptic-type equation by the method of rotational displacements was considered in an arbitrary domain with a piecewise smooth boundary. A system of lines was selected; and the range of variation was divided into partial intervals, with the system of lines fixed in each of the intervals. Two cases are considered, that of exits onto new lines as well as departure from lines; and it is shown that the two cases can be combined.
M.W.R.

N68-30120*# Illinois Univ., Urbana. Physics Dept.
THE STABILITY OF MOTION IN A PERIODIC CUBIC FORCE FIELD
Curtis Arthur Wagner 1 Jun. 1968 156 p refs
(Grant NsG-280-63)
(NASA-CR-95836; TR-3) CFSTI: HC$3.00/MF$0.65 CSCL 12A

The possible existence of closed invariant regions of stability for solutions of a particular nonlinear differential equation associated with dynamical systems is numerically investigated using a high speed digital computer. This is done by piecewise integration in terms of Jacobian elliptic functions. The FORTRAN programs for these computations are included. Successive solutions of the equation are computed and clearly show the existence of a closed invariant region associated with particular solutions of the equation. It is also shown that solutions initially inside the invariant region always map inside this region, even after an infinite number of repeated mappings of the phase-space. The points are called stroboscopically stable.
D.H.B.

N68-30151*# Brown Univ., Providence, R. I.
DYNAMICAL SYSTEMS AND STABILITY
Jack K. Hale [1968] 36 p refs
(Grants NGR-40-002-015; AF-AFOSR-693-67; NSF GP-7471; Contract DA-31-124-ARO(D)-270)
(NASA-CR-95868) CFSTI: HC$3.00/MF$0.65 CSCL 12A

The concept of the limit set of an orbit through a point is considered in terms of the theory of the dynamical system on a Banach space; and, for certain classes of equations, it is shown that bounded orbits belong to compact sets. Different types of topologies that may be introduced on the state space for ordinary, functional, and partial differential equations in order to obtain dynamical systems are discussed, as are the limit sets and stability to be applied to limit dynamical systems. Theory is applied to specific dynamical systems, and the relationship of limit dynamical systems to an extended system is considered.
M.W.R.

N68-30198*# Brown Univ., Providence, R. I. Center for Dynamical Systems.
A MULTIPOINT METHOD OF THIRD ORDER
W. E. Bosarge, Jr. and P. L. Falb [1968] 17 p refs
(Grant NGR-40-002-015; AF-AFOSR-693-67)
(NASA-CR-95867) CFSTI: HC$3.00/MF$0.65 CSCL 12A

Let F be a mapping of the Banach space X into itself. A convergence theorem for the iterative solution of $F(x) = 0$ is proved for the multipoint algorithm $x_{n+1} = x_n - \phi(x_n)$ where $\phi(x) = F_x^{-1}[F(x) + F(x - F_x^{-1}F(x))]$ and F_x is the Frechet derivative of F. The theorem guarantees that, under appropriate conditions on F, the multipoint sequence $|x_n|$ generated by ϕ converges cubically to a zero of F. The algorithm is applied to the nonlinear Chandrasekhar integral equation. A discretization of the equations of iteration is discussed, and some numerical results are given.
Author

N68-30216 Brown Univ., Providence, R. I.
SOME APPLICATIONS OF FUNCTIONAL ANALYSIS TO APPROXIMATION THEORY
Frank Richard Deutsch (Ph.D. Thesis) 1966 112 p
Available from Univ. Microfilms: HC $5.60/MF $3.00 Order No. 67-2230

Various aspects of approximation in an arbitrary normed linear space are considered. The main result from a study of simultaneous interpolation and approximation in normed linear spaces is a generalization of a theorem due to J. L. Walsh. As a particular corollary, it is shown that the Stone–Weierstrass approximation theorem is actually one concerning *simultaneous* interpolation and approximation. In other corollaries, the existence of various rules, which are uniformly good over a space and are exact over a subspace, are established. It is also shown that many constrained approximation problems can be replaced by unconstrained ones or a sequence of unconstrained ones. Duality in approximation theory is considered and a duality theorem using a simple geometric approach is obtained. A general theorem characterizing the best approximations in a convex set to an arbitrary given point outside the set is also obtained. These results are then used to obtain a practical scheme for effectively determining best approximations and lower bounds on the error of approximation. Dissert. Abstr.

N68-30250# Joint Publications Research Service, Washington, D. C.
REGULATION OF MOTION ENCOUNTER PROBLEM
12 Jul. 1968 8 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 179, no. 2, 1968 p 300–303
(JPRS-45913) CFSTI: HC $3.00/MF $0.65

Equations are given for controllable motions that are described by n-dimensional phase coordinate vectors, and all of the vectors are interpreted as column-vectors. The problem of encounter between two motions consists in selecting a control that will insure a given equality. The procedure described for shaping the control in a series of standard cases insures a minimax of the time before encounter. M.W.R.

N68-30271* Techtran Corp., Glen Burnie, Md.
ABEL'S GENERALIZED EQUATION AND THE CAUCHY KERNEL EQUATION [OBOBSHCHENNOYE URAVNENIYE ABELYA I URAVNENIYE S YADROM KOSHI]
S. G. Samko Washington NASA Jul. 1968 7 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 176, no. 5, 1967 p 1019–1022
(Contract NASw-1695)
(NASA-TT-F-11775) CFSTI: $3.00 CSCL 12A

This work represents an investigation of the normal solvability of Abel's generalized integral equation from the standpoint of its relationship to the Cauchy kernel equation, where all functions are assumed to be real. The relations involved in this study are presented and the pertinent equations are derived. Author

N68-30278# European Atomic Energy Community, Ispra (Italy). Scientific Information Processing Center.
APPLICATION OF REMEZ SECOND ALGORITHM TO THE BESSEL FUNCTIONS J0, J1 AND I1
R. F. Gloden Brussels Jun. 1968 32 p refs In FRENCH; ENGLISH summary
(EUR-3926.f) CFSTI: $3.00

In a former work we approached, by resolution of a linear system, the function $J_0(x)$, $-8 \leq x \leq +8$, in the sense of TSCHEBYSCHEFF, by means of a polynomial of degree 27, the coefficients of the odd powers of the variable being zero. By approximating the function $J_0(8\sqrt{x})$, $0 \leq x \leq 1$, by means of a polynomial of degree 13 in x, using an iterative process constituted of the second algorithm of REMEZ, we are able to partially answer the question, whether the coefficients obtained initially can be improved or not. Author

N68-30329# Ecole Polytechnique, Paris (France). Centre de Physique Theorique.
ABOUT O'RAIFEARTAIGH'S THEOREM
Gerard Fuchs Mar. 1968 13 p refs
(NP-17452; A113.368(6))

A study of the previously made conjecture that any semi-simple Lie algebra G having Poincare as a subalgebra also contains a dilation (i.e., an element commuting with the Lorentz generators and having translation generators for eigenvectors) is presented. It is shown that the conjecture which would have given a result somewhat more precise than O'Raifeartaigh's theorem and of purely algebraic nature is not true. A rule is given to construct counter examples of arbitrarily high dimension for any type of algebra. NSA

N68-30385*# University of Southern Calif., Los Angeles. Dept. of Electrical Engineering.
A MONTE CARLO APPROACH TO MEAN-SQUARE APPROXIMATION
W. S. Meisel [1968] 12 p
(Grant NGL-05-018-044)
(NASA-CR-95885) CFSTI: HC $3.00/MF $0.65 CSCL 12A

An algorithm for mean square approximation is presented. It is useful in both the case where the distribution function defining the mean is known and when it is represented solely by a finite number of samples, and may often be applied when other methods are impractical. The amount of storage required is independent of the number of sample points. Author

N68-30406# Stanford Univ., Calif. Dept. of Statistics.
SEQUENTIAL RELIABILITY ASSURANCE IN FINITE LOTS
K. T. Wallenius 22 Apr. 1968 31 p refs
(Contract Nonr-225(52))
(TR-1351; AD-669791)

Efficient sequential stopping rules are developed which assure fixed length lower confidence limits on lot reliability when inspection is of the rectifying type. Several models of production processes are defined and analyzed: A nonparametric model; parametric models; parametric models with prior distributions. Author (TAB)

N68-30411# Missouri Univ., Columbia.
CONVERGENCE RATES FOR WEIGHTED SUMS OF RANDOM VARIABLES Final Status Report, 1 Oct. 1964–29 Feb. 1968
David Lee Hanson and H. D. Brunk 20 Apr. 1968 5 p refs
(Grant AF-AFOSR-746-65A)
(AFOSR-68-1072; AD-669771)

Let X sub 1, X sub 2, ... be independent random variables and let a sub (nk) be constants. Let S sub n = 1/n (Summation from k=1 to k=n of (X sub k - EX sub k)) and let A sub n = Summation from k=1 to k = infinity, of a sub (nk) (X sub k - EX sub k). The main purpose of this study was the investigation of the rate of convergence of P(absolute value of A sub n > epsilon) to zero under various assumptions on the X sub ks. In addition to the main results, results were obtained in ergodic theory, maximum likelihood estimation, testing against trend, and bidding theory. Author (TAB)

N68-30413# Naval Weapons Lab., Dahlgren, Va.
THE METHOD AND USE OF NOVACOM, A PROGRAM FOR "NON-ORTHOGONAL" ANALYSIS OF VARIANCE AND COVARIANCE
Klaus Abt 19 Apr. 1968 207 p refs
(NWL-TR-2108; AD-669899)

The report contains the description of a program (NOVACOM) for the solution of problems in the area of analyzing data based on the general linear statistical model. While the detailed program documentation is given elsewhere, the present publication deals

with the statistical method, the logical flow, and the use and application of NOVACOM in multiple linear regression and (non-orthogonal) analysis of variance and covariance for crossed classifications with incomplete and unbalanced data. The method of NOVACOM is basically a backward ranking procedure applied to individual and/or groups of independent variables (concomitant) independent variables and/or ANOVA effects, respectively. The result of the ranking is a model (significant model) which contains only significant concomitant independent variables and/or ANOVA effects. The method and use of the program is illustrated by examples of the statistical analysis of bodies of incomplete experimental data. Author (TAB)

N68-30414# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.

PROOF OF THE CONVERGENCE OF THE EIGENFUNCTIONS OBTAINED BY THE METHOD OF FINITE DIFFERENCES

V. K. Saul'ev 2 Apr. 1968 14 p refs Transl. into ENGLISH from Usp. Mat. Nauk (USSR), v. 9, no. 4(62), 1954 p 217–224
(Contract NOw-62-0604-c)
(TG-230-T549; AD-669946)

The fixed membrane problem is solved by a finite difference method. A proof for the convergence of the eigenfunctions is given. TAB

N68-30425# Bettis Atomic Power Lab., Pittsburgh, Pa.

ON PROOFS OF THE UNIQUENESS AND POSITIVITY OF THE SOLUTION VECTOR FOR VARIOUS APPROXIMATIONS TO THE FIXED SOURCE TIME INDEPENDENT NEUTRON TRANSPORT EQUATION

D. S. Rampolla Apr. 1968 27 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-TM-730) CFSTI: HC $3.00/MF $0.65

A straightforward method is used to prove the positivity and uniqueness of the solution to the time independent fixed source Boltzmann equation and several commonly used approximations. This method provides some interesting insight into the structure of the equations, and can readily be applied to other inhomogeneous equations. Author (NSA)

N68-30497# Eidgenossische Technische Hochschule, Zurich (Switzerland).

ALGEBRAS WITH MULTIPLICATIVE STRUCTURES [ALGEBREN MIT MULTIPLIKATIVEN STRUKTUREN]

Heinz Vogele (Ph.D. Thesis) 1967 30 p refs In GERMAN
(Diss. Nr. 3906) CFSTI: HC $3.00/MF $0.65

Developed is the group-like structure of general algebras through formulating their associativity and commutativity multiplication and inverse properties by addition axioms. A H_2- or multiplication structure is defined into a dual H^2-structure by construction and factorization of products and coproducts with subsequent transformation into sets of algebraic topology. Transl. by G.G.

N68-30514# Ballistic Research Labs., Aberdeen Proving Ground, Md.

A DIGITAL ROUTINE FOR CONSTRUCTING ORDINARY AND TIME DELAY ROOT LOCUS DIAGRAMS BY THE METHOD OF A. M. KRALL

Lawrence L. Hoberock and Patricia J. Waugh May 1968 42 p refs
(BRL-MR-1924; AD-670021)

The report describes a digital computer routine for calculating root loci and automatically plotting the corresponding root locus diagrams in any specified region of the complex root plane. It is designed for use with characteristic functions with or without a time-delay term. The routine was written in Fortran IV by A. M. Krall and R. Fornaro at The Pennsylvania State University, and was adopted by the authors for use with the BRLESC digital computer and CALCOMP Model 780 digital plotting system at the U. S. Army Ballistic Research Laboratories. Author (TAB)

N68-30517# California Univ., Berkeley. Operations Research Center.

APPROXIMATIONS TO SYSTEM RELIABILITY USING A MODULAR DECOMPOSITION

Lawrence David Bodin Jul. 1967 22 p refs
(Contracts Nonr-3656(18); DA-31-124-ARO(D)-331; Grant NSF GP-7417)
(ORC-67-42; AD-669902)

Esary and Proschan show that a lower bound to system reliability can be found by enumerating all min cut sets in the coherent structure, connecting the components in each min cut set in parallel and joining each of these parallel subsystems in series where replicated components are replaced by identical yet independently operating components. A module of a coherent structure is a subset of the basic components of the system which can be treated as a component of the system due to their substructure topology. In this paper, it is shown that a lower bound estimate of system reliability can be derived by decomposing the coherent structure about its modules and applying the Esary-Proschan lower bound procedure to each module and then to the resultant coherent structure where each module has been replaced by a single component whose reliability is the Esary-Proschan lower bound to that module. Author (TAB)

N68-30532# New York Univ., N. Y., AEC Computing and Applied Mathematics Center.

INTEGRALS OF NONLINEAR EQUATIONS OF EVOLUTION AND SOLITARY WAVES

Peter D. Lax Jan. 1968 52 p refs
(Contract AT(30-1)-1480)
(NYO-1480-87) CFSTI: HC $3.00/MF $0.65

A general principle for associating nonlinear equations of evolutions with linear operators so that the eigenvalues of the linear operator are integrals of the nonlinear equation is presented. A striking instance of such a procedure is the discovery by Gardner, Miura and Kruskal that the eigenvalues of the Schroedinger operator are integrals of the Korteweg–de Vries equation. Also, the simplest case of a conjecture of Kruskal and Zabusky is proven concerning the existence of double wave solutions of the Korteweg–de Vries equation, i.e., of solutions which for $|t|$ large behave as the superposition of two solitary waves traveling at different speeds. The main tool used is the first of a remarkable series of integrals discovered by Kruskal and Zabusky. Author (NSA)

N68-30537# Wisconsin Univ., Madison. Dept. of Statistics.

ON THE DISTRIBUTION OF SOME STATISTICS USEFUL IN THE ANALYSIS OF JOINTLY STATIONARY TIME SERIES

Grace Wahba Feb. 1968 26 p refs
(Grants NSF GP-4265; AF-AFOSR-1158-66)
(TR-145; AD-670173)

Contents: Circulant matrices; The joint distribution of circulent forms in jointly circulant normal random vectors; Asymptotic behavior of quadratic forms in stationary gaussian processes; Applications to hypothesis testing for stationary time series. TAB

N68-30549# Stanford Univ., Calif. Dept. of Statistics.

ESTIMATING THE PARAMETERS OF A CONVOLUTION

Stanley L. Sclove and John Van Ryzin 10 May 1968 26 p refs
(Contract Nonr-225(52))
(TR-136; AD-669792)

The report treats some parametric estimation problems in which one observes a random variable which is the sum of

two independent nonidentically distributed random variables. Some basic identifiability theorems are given which suggest the method of moments as a general method for attacking such problems, particularly when one of the summand variables is discrete. Moment estimators and their asymptotic distributions are examined for various specific examples. Author (TAB)

N68-30558# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
ON THE ESTIMATION OF CERTAIN SUMS FOR A FUNCTION DEFINED ON A MESH
S. L. Sobolev 27 Mar. 1968 20 p refs Transl. into ENGLISH from Akad. Nauk SSSR, Ser. Mat., v. 4, no. 1, 1940 p 5–16
(Contract NOw-62-0604)
(APL-TG-230-T553; AD-669938)

In this paper the author extends his previous estimates for families of functions with integrable derivatives. These estimates remain valid if the derivatives are replaced by corresponding difference relations. TAB

N68-30586 Calif. Univ., San Diego.
WELDING RIEMANN SURFACES AND TRANSMISSION PROBLEMS WITH A SHIFT
Donald Lawrence Orth (Ph.D. Thesis) 1967 174 p
Available from Univ. Microfilms: HC $8.00/MF $3.00 Order No. 67-12287

It is shown that there is a large class of transmission problems with shift on Riemann surfaces generalizing those in the sense of Haseman and Carleman such that for each member of this class there is an associated holomorphic fiber bundle over the corresponding welded Riemann surface for which the solution space of the problem is functorially isomorphic to the space of global holomorphic sections in the associated bundle. Known results about holomorphic fiber bundles on Riemann surfaces can then be used to describe these solution spaces. The association can also be used to find one between a class of singular integral equations with shift on compact Riemann surfaces and a class of holomorphic affine bundles over compact Riemann surfaces so that for any equation in this class there is a surjection from the space of global holomorphic sections in the associated affine bundle to the space of solutions of the integral equation. Dissert. Abstr.

N68-30594*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A VECTOR APPROACH TO THE ALGEBRA OF ROTATIONS WITH APPLICATIONS
Paul B. Davenport Washington Aug. 1968 25 p refs
(NASA-TN-D-4696) CFSTI: HC $3.00/MF $0.65 CSCL 12A

A new type of vector multiplication defines a group (whose elements are vectors) isomorphic to the group of rotations. This allows a vector representation of rotations which has many advantages over the usual matrix or Eulerian angles approach, e.g., this vector representation avoids the need for trigonometric relationships and requires only three independent parameters. Several applications show the simplicity of this vector representation—in particular, an analytic solution to a least squares rotation problem. The differential equations defining the motion of a rigid body are obtained in terms of a vector differential equation. Author

N68-30613# Wisconsin Univ., Madison. Statistics Dept.
DISTRIBUTION OF RESIDUAL AUTOCORRELATIONS IN INTEGRATED AUTOREGRESSIVE-MOVING AVERAGE TIME SERIES MODELS
G. E. P. Box and David A. Pierce Apr. 1968 45 p refs
(Grant AF-AFOSR-1158-66)
TR-154; AD-670174)

It is shown that to a close approximation the residuals from any moving average or mixed autoregressive - moving average process will be the same as those from a suitably chosen autoregressive process. The adequacy of this approximation is confirmed by empirical calculation. It follows from this that one need not consider separately these two classes of processes. TAB

N68-30632* Techtran Corp., Glen Burnie, Md.
CONVERGENCE RATES OF PROJECTION METHODS FOR CERTAIN NONSTATIONARY PROBLEMS [O SKOROSTI SKHODIMOSTI PROYEKTSIONNYKHMETODOV DLYA NEKOTORYKH NESTATSIONARNYKH ZADACH]
V. K. Dem'yanovich and Yu. K. Dem'yanovich Washington NASA Jul. 1968 9 p refs Transl. into ENGLISH from Vestn. Leningr. Univ., Ser. Mat., Mekh. i Astron. (Leningrad), v. 22, 1967 p 147–152
(Contract NASw-1695)
(NASA-TT-F-11815) CFSTI: $3.00 CSCL 12A

The purpose of this work is to estimate the convergence rates of the grid method, straight line method, and method of integral relations for nonstationary problems with an elliptical operator of order 2k in regions with an irregular boundary, under broad assumptions relating to the smoothness of the coefficients and in the case where a discrete time interval is used. The interest is to reveal the dependence of these methods on the nature of the initial condition. Author

N68-30645# British Columbia Univ., Vancouver. Mathematics Dept.
THEORY OF ELLIPTIC BOUNDARY PROBLEMS Final Technical Report
Charles A. Swanson and Colin W. Clark May 1968 10 p refs
(Grant AF-AFOSR-68-1147)
(AFOSR-68-1147; AD-670181)

The final report summarizes work done in the area of singular elliptic operators, which include asymptotic distribution of eigenvalues, embedding theorems, and perturbation theory. The second part of this work concerns comparison and oscillatory behavior of solutions of linear elliptic partial differential equations. Author (TAB)

N68-30706 Czechoslovak Academy of Sciences, Prague.
THE USING OF CARTAN'S METHODS FOR THE STUDY OF A GENERAL NET OF CURVES ON A SURFACE IN THREE-DIMENSIONAL PROJECTIVE SPACE [UZITI CARTANOVYCH METOD KE STUDIU OBECNE SITE KRIVEK NA PLOSE V TROJROZMERNEM PROJEKTIVNIM PROSTORU]
Ivan Kolar 1967 73 p refs In CZECH; ENGLISH summary
Its vol. 77, no. 5

The use of Cartan's method of specialization of frames to study a net on a surface in a three dimensional projective space is presented. Consideration is also given to the theoretical questions that concen the more general problem of constructing the canonical frame of a system of submanifolds on a manifold in an arbitrary homogeneous space. B.S.D.

N68-30718*# Scripta Technica, Inc., Washington, D. C.
LINEAR DIFFERENTIAL GAMES. 2 [O LINEINYKH DIFFERENTSIAL'NYKH IGRAKH. 2]
L. S. Pontryagin Washington NASA Jul. 1968 5 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 175, no. 4, 1957 p 764–766
(Contract NASw-1694)
(NASA-TT-F-11560) CFSTI: HC $3.00/MF $0.65 CSCL 12A

Analysis extending some previous considerations concerning the improvement of results obtained for a certain class of games associated with a vector differential equation dz/dt = Cz + u-v given in a space R of arbitrary dimensionality such that z = R

(C is a square matrix, and u and v are control parameters). The new results are formulated and improved by introducing certain operations involving convex sets and, in particular, the operation of alternate integration of convex sets. All sets examined are closed subsets of the space R. Author

N68-30804*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
CALCULATIONS OF CHANDRASEKHAR'S X- AND Y-FUNCTIONS AND THEIR ANALOGS FOR NONCOHERENT ISOTROPIC SCATTERING
Franklyn B. Fuller and B. Jeanne Hyett Washington Aug. 1968 147 p refs
(NASA-TN-D-4712) CFSTI: HC $3.00/MF $0.65 CSCL 12A

Results of calculations of the X- and Y-functions of Chandrasekhar, and of their analogs for noncoherent isotropic scattering are given. In the noncoherent work, a Doppler profile is assumed. The results are presented both as tables and in a convenient graphical form, conducive to understanding the behavior of these complicated functions. Moments of the X- and Y-functions are also presented. The method of calculation is based on reduction to the solution of an initial value problem. A simple analytic approximation derived from this method is briefly discussed. Author

N68-30837# Aerospace Corp., El Segundo, Calif. Lab. Operations.
PERMANENCE OF THE LOG-NORMAL DISTRIBUTION
Richard L. Mitchell Feb. 1968 28 p refs
(Contract FO4695-67-C-0158)
(TR-0158/3230-46/-12; SAMSO-TR-68-175; AD-670159)

The distribution of the sum of log-normal variates is shown for most cases of interest to be very accurately represented by a log-normal distribution instead of a normal or Rayleigh distribution that might be expected from the central limit theorem. As a result, the observance of the log-normal distribution for the fluctuations in received intensity for propagation in a random medium can be readily explained, regardless of the size of the receiving aperture. In every case, the log-normal distribution is a better representation than the normal for the distribution of the sum of log-normal variates. However, in some cases not even the log-normal distribution is very accurate. The questions of convergence and accuracy are examined in detail. Author (TAB)

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N68-29638# Weather Wing (1st), San Francisco, Calif.
OBJECTIVE METHOD TO FORECAST GUSTY SURFACE WINDS AT MACTAN AB, PHILIPPINES
May 1968 13 p *Its* Tech. Study 18
(AD-669366)

The relationship between the maximum surface wind gusts and the maximum wind speed in the lowest 10,000 feet is used to develop an objective technique to forecast surface wind gusts equal to or exceeding 20 knots at Mactan Air Base. Considering only the days when gusty surface winds are likely, the dependent sample shows 73% correct forecasts and a Heidke skill score of 0.46. The corresponding figures for the independent data are 69% and 0.39. Author (TAB)

N68-29725# Environmental Technical Applications Center (Air Force), Washington, D. C.
METEOROLOGICAL ROCKET DATA AND PREDICTING THE ONSET OF THE SOUTHWEST MONSOON OVER INDIA AND SOUTHEAST ASIA
Edward V. von Gohren May 1968 16 p refs
(ETAC-TN-68-2; AD-669364)

Recent independent results from several sources encourage the further consideration of highly probable correlations between the time of the onset of the southwest monsoon over southern South Vietnam, the advance of the southwest monsoon up the west coast of India, and stratospheric and mesospheric dynamics. This paper discusses these independent results, expresses the authors observations on the topic, and shows that an interrelationship or correlation exists between the southwest monsoon and the stratospheric circulation. This information is presented as an example of the value of synoptic meteorological rocket network data. Author (TAB)

N68-29745# Weather Squadron (11th), Elmendorf AFB, Alaska. Scientific Services Section.
A CLIMATOLOGICAL GUIDE TO ALASKAN WEATHER
Billie E. Grubbs and Billie E. Grubbs, Jr. May 1968 97 p
(AD-669344)

The paper was designed to provide a climatological guide to Alaskan weather. As such, it defines five climatic regions within Alaska and describes the conditions which combine to produce the observed regional climates. It is not intended to be a forecasting manual or a detailed analysis of weather factors or terrain peculiarities affecting specific locations. Enough information is included, however, for squadron or detachment personnel to prepare complete seasonal climatological briefings on any general area within Alaska. Author (TAB)

N68-29811# Air Force Cambridge Research Labs., Bedford, Mass. Aerospace Instrumentation Lab.
DURATION OF COLD TEMPERATURE OVER NORTH AMERICA
Paul I. Tattelman Apr. 1968 31 p refs *Its* Environ. Res. Papers, No. 286
(AFCRL-68-0232; AD-669567)

The duration of temperature as low as -60F over North America is presented. Data from 106 stations across the United States and Canada were tabulated to provide the longest period of temperature at or below eight threshold temperatures in ten years. Also depicted are expected (approximately 50 percent probability) duration of six threshold temperatures during any single winter season. Durations at or below -60F have exceeded 48 hours in the Yukon, but the longest duration of -40F over the contiguous United States was only two hours along the Canadian border of North Dakota. Author (TAB)

N68-30011# Army Electronics Labs., Fort Monmouth, N. J.
ATMOSPHERIC ELECTRICITY PROGRAM, FLAGSTAFF, ARIZONA, PART 1
E. M. Frisby and E. H. Schwartz Dec. 1967 15 p ref
(ECOM-2907; AD-669589)

The report summarizes the weather conditions that were encountered during two of the three weeks (9-21 July 1967) comprising the Army/Environmental Science Service Administration (ESSA) summer program on atmospheric electricity held at Flagstaff, Arizona, in July 1967. Short as the program was, it contained an excellent example of the pulsing effect of the monsoon. In addition to the meteorological summary, the report includes a discussion of flight and weather experience, suggesting a relationship between high electrical fields and the presence of ice in the atmosphere, whether in hailstone or crystal form. Author (TAB)

N68-30053# Texas Univ., Austin. Atmospheric Science Group.
MESOSCALE SURFACE TEMPERATURE CHARACTERISTICS OF THE TEXAS COAST SEA BREEZE
Shih-ang Hsu May 1967 83 p refs
(Grant NSF GA-367)
(Rept.-6)

Surface temperature data taken in June 1966 on the Upper Texas Gulf Coast are examined for evidence that the space and time variations in the field are significantly influenced by the sea breeze circulation system. Two instrument comparison tests were performed on the coast and five more in Austin. These are examined statistically for evidence of bias and of random error. Mesoscale temperature patterns are presented as a function of both space and time. Gradients in the vicinity of the seashore are highlighted through the detailed examination of reports from a small scale, dense network of instruments which were aligned perpendicular to the coastline for a one day period. Author

N68-30075# Finnish Meteorological Office, Helsinki.
TABLES AND MAPS OF PRECIPITATION IN FINLAND, 1931–1960 [TAULUKOITA JA KARTTOJA SUOMEN SADEOLOISTA KAUDELTA 1931–1960]
U. I. Helimaki 1967 30 p In FINNISH and ENGLISH
CFSTI: HC$3.00/MF$0.65

An overview is presented on the methods of recording precipitation and of preparing point value maps. Tabulations show precipitation stations and average precipitation, and number of precipitation days. Maps depict the average precipitation for each month, the annual precipitation, the isohyets based on point values, and precipitation days for both ≥0.1 mm and ≥1.0 mm for the 1931–1960 period. M.G.J.

N68-30169# Inter-Range Instrumentation Group, White Sands Missile Range, N. Mex. Meteorological Working Group.
IRIG STANDARDS FOR RANGE METEOROLOGICAL DATA REDUCTION. PART 1: RAWINSONDE
Aug. 1967 80 p
(IRIG-MWG-108-67-PT-1; AD-669393)

The measurement of atmospheric parameters to support activities on national and service ranges involves the entire meteorological environment from the most simple observation of data near the surface to the complex and difficult measurements of high altitude parameters by the use of rocket and satellite-borne instrumentation. The specific techniques used for the reduction of meteorological data varies between ranges because the methods have evolved from individual efforts. In an attempt to alleviate this problem and with the additional goal of producing the best possible data, the meteorological working group of the interrange instrumentation group proposed the task of standardizing the methods used in the reduction of range meteorological data. Author (TAB)

N68-30171# Joint Publications Research Service, Washington, D. C.
NORMS FOR SEEDING DRY ICE IN CLOUDS AND FOGS
I. P. Polovina 10 Jul. 1968 14 p refs Transl. into ENGLISH from the Publ. "Trudy Ukrainskogo Nauchno-Issedovatel'skogo Gidrometeorologicheskogo Instituta" USSR, no. 61, 1966 p 41–49
(JPRS-45891) CFSTI: HC$3.00/MF$0.65

This article presents the results of experiments for the modification of supercooled stratus and stratocumulus clouds by dry ice for their dissipation. Experimental data were used in refining current ideas on the dependence of the norms for expenditure of CO_2 on cloud thickness. The author analyzes the effect of dry ice at a temperature above −4°, high wind velocities and ejection at various levels above the upper boundary. Author

N68-30194# Texas Univ., Austin. Atmospheric Sciences Group.
TWO-DIMENSIONAL STATISTICAL OBJECTIVE ANALYSIS OF ISOTROPIC SCALAR DATA FIELDS
Amos Eddy May 1967 107 p refs
(Grant NSF GP-3746)
(Rept.-5)

The purpose of this study has been to develop an objective analysis procedure which can be used as a research tool to examine, to a first degree of approximation, the information content of sets of direct observations sampled from a meteorological scalar field. Variations in both time and space of components of the variance are discussed using data sets selected from all four seasons and from several levels in the troposphere and stratosphere. The Northern Hemisphere defines the horizontal extent of the sampled field. While the analysis scheme is basically a least-squares interpolation procedure, the regression is effected in such a way as to permit a statement of the extent to which various scales are filtered from the observations set. Author

N68-30199# Research Triangle Inst., Durham, N. C.
RESEARCH IN NUMERICAL, DYNAMICAL, AND OPERATIONAL WEATHER FORECAST PROCEDURES Final Report, 15 Jan. 1966–14 Mar. 1967
Fred M. Vukovich and Chi F. Chow 14 Apr. 1968 99 p refs
(Contract AF 19(628)-5834)
(AFCRL-68-0206; AD-669332)

An analysis of various numerical prediction errors of the Global Weather Center, six-level model was performed. The most persistent errors in 12-hour vertical motions ranged between plus or minus 40 mbs at 850 mbs and plus or minus 25 mbs at 500 mbs. Up to 50% of this error was accounted for by slight changes in stability; and diabatic heating produced 12-hour vertical displacements of the same order of magnitude as the error. A case study of the effect of the omission of vertical advection term in the vorticity equation showed that the most significant contribution of this term was in the form of cyclonic vorticity, and that these contributions fell in regions where anticyclonic vorticity was overestimated, reducing this error by as much as 45%. However, a scatter plot of the vorticity error versus the vertical advection term showed a preponderance of cyclonic contribution by vertical advection but these fell equally well in regions where cyclonic and anticyclonic vorticity were overestimated. There was a strong correlation between heating and cooling distribution and surface flow patterns. The height errors also correlated with the heating distribution. It was shown that latent and surface heating accounted for a major portion of the positive height error. Author (TAB)

N68-30251# Finnish Meteorological Office, Helsinki.
METEOROLOGICAL YEARBOOK OF FINLAND, VOLUME 57, PART 1A: CLIMATOLOGICAL DATA, 1957 [SUOMEN METEOROLOGINEN VUOSIKIRJA, NIDE, 57 OSA 1A: ILMASTOHAVAINNOT, 1957]
1967 71 p In ENGLISH and FINNISH
CFSTI: HC$3.00/MF$0.65

Tables of annual climatological data for 99 stations in Finland are compiled. Daily observations from six stations are tabulated showing air pressure, air temperature, maximum and minimum daily temperatures; relative humidity, wind direction and speed, precipitation, cloud cover, depth of snow, and weather phenomena. Monthly and yearly values for the 99 stations are compiled to show mean air pressures, naxi num and minimum monthly and yearly mean temperatures, absolute maximum and minimum temperatures, wind distribution, relative humidity, cloud amount, total precipitation, number of days of specified phenomena. D.H.B.

N68-30287# Federal Aviation Administration, Atlantic City, N. J. National Aviation Facilities Experimental Center.
DISPLAY OF WEATHER CONTOURS Interim Report
Donald W. Connolly Aug. 1968 41 p
(NA-68-29)

The Weather Outline Contour Generator outlines areas of weather clutter at different intensity levels. Three experiments and several additional tests were performed to investigate two principal problem areas regarding the human factors aspects of the display of such data. The first problem concerned resolution—the level of detail or continuity required for reasonably complete and accurate representation of the shape and extent of the area of precipitation. This was tested by a recognition procedure. Twenty-three controllers correctly recognized, over 90 percent of the time, which of four actual weather patterns was represented by an outline made up of symbols spaced radially approximately 2-2/3° apart. Doubling or quadrupling the resolution improved recognition slightly while increasing the certainty of recognition to a greater degree. The second general question concerned usefulness, for vectoring, of the symbolic outline vs. the hatched display. No differences were found between displays in number of vectors issued or time under control. The 2-2/3° resolution was used in both cases and vectoring performance using either outline did not differ from that where the raw, broadband weather was used. However, the radial-hatched contours were found to be more visible in clutter and other symbology, and to result in slightly better weather avoidance. Author

N68-30293# Bureau of Meteorology, Melbourne (Australia).
RESTRICTED VISIBILITY STATISTICS, SELECTED WESTERN AUSTRALIAN STATIONS
R. Maine Feb. 1968 66 p
CFSTI: HC $3.00/MF $0.65

The reports of visibility below three miles at eight selected western Australian airports have been studied. Frequency tables and probability of occurrence are calculated for various visibility ranges for each month. Cases where visibility has been reduced by fog or fog patches are treated separately and tables of minimum visibility and duration of fog affected periods are presented. It is found that the distances of reference objects used for visibility estimation have affected the discrimination of the visibility estimates. Author

N68-30402# RAND Corp., Santa Monica, Calif.
SOVIET DEVELOPMENT AND USE OF DRIFTING AUTOMATIC RADIOMETEOROLOGICAL STATIONS FOR ARCTIC RESEARCH
S. M. Olenicoff May 1968 76 p refs
(Contract F44620-67-C-0045; Proj. RAND)
(RM-5624-PR; AD-669802)

A compilation and discussion of all available information on the Soviet development of drifting automatic weather stations and radio beacons and their deployment in the Arctic Basin. Although no detailed instrumentation data have appeared in the open literature, general information on the design and history of the Alekseyev beacons and DARMS has appeared in Russian scientific publications. The DARMS weighs only 450 lbs and covers 40 sq ft. It is tuned to a fixed frequency and can be activated and interrogated by ship, shore, or aircraft. Its 40-w transmitter has a wavelength of 430 to 630 m and a range of 800 to 1500 km. The automatic stations can be deployed on the drifting ice by aircraft or ice-breaker; installation requires less than an hour. From 1953 through 1965, 133 beacons and 141 DARMS were deployed. Author (TAB)

N68-30543# Joint Publications Research Service, Washington, D. C.
METEOROLOGY
In its Soviet-Bloc Res. in Geophys., Astronomy, and Space, No. 184 22 Jul. 1968 p 8–26 refs (See N68-30541 18-34)

News reprints and abstracts of scientific articles on meteorology are taken from the Soviet-bloc literature. Weather forecasting, climatology handbooks, books on hydrogeological mapping and hydrometry, and electrical measurements of aerophysical values are covered in the news items. Abstracts report the flux of long wave radiation in boundary layer of clouds, computing atmospheric counter-radiation, vertical structure of radar echoes from hail clouds, and diurnal changes in radom exhalation and concentration. Other topics are variations in near-water atmospheric layer, atmospheric movements and radioactivity variations, stimulating growth of air-mass cumulus clouds, and moisture content indices in permafrost regions of the Soviet. Numerical methods of weather forecasting and underwater springs in the Black Sea are considered. M.W.R.

N68-30612# Weather Bureau, Washington, D. C.
SECONDARY BIBLIOGRAPHY ON THE CLIMATE OF VENEZUELA
1967 13 p refs
(WB/BC-27; AD-670045)

The document lists 51 reports by title and author, and includes descriptive comments concerning the content of these reports. TAB

N68-30640# Weather Bureau, Silver Spring, Md.
AN ANNOTATED BIBLIOGRAPHY ON THE CLIMATE OF THE PHILIPPINES
Virgilio Torres and Henry Hacia May 1968 82 p refs
(WB/BC-98; AD-669879)

The document lists 244 reports by title and author, and includes descriptive comments concerning the content of these reports. TAB

N68-30667# Army Tropic Test Center, Fort Clayton (Canal Zone).
ENVIRONMENTAL DATA BASE FOR REGIONAL STUDIES IN THE HUMID TROPICS Monthly Microclimatic Summary, Sep. 1967
Michael A. Fradel and Wilfried H. Portig Apr. 1968 27 p
(AD-669594)

The report contains detailed microclimatic data for September 1967 from specific sites in the Panama Canal Zone and vicinity. The data are presented in tabular form, summarized for hourly and/or daily observations from surface to 46-meter levels. Elements listed are: temperature, pressure, precipitation, wind speed and direction, relative humidity, and evaporation. Author (TAB)

N68-30735# Bureau of Meteorology, Melbourne (Australia).
TROPICAL CYCLONES IN THE NORTHERN AUSTRALIAN REGIONS FOR 1964–65 SEASON
Feb. 1968 92 p
CFSTI: HC $3.00/MF $0.65

Tropical cyclone data recorded by three Tropical Cyclone Warning Centers responsible for the northern, northeastern, and northwestern regions of Australia are reported. The tropical disturbances in each Australian Region are alloted sequence numbers and classified as follows: (1) major tropical cyclones associated with winds exceeding 33 knots and extending more than 100 miles from the center; (2) tropical cyclones associated with winds exceeding 33 knots but not extending more than 100 miles from the center; and (3) minor tropical disturbances associated with wind speeds not exceeding 33 knots. Diagrams showing the tracks of the storms and central pressures are included. For each Region a list is given showing the number, class, dates of operation, and location affected for each disturbance. Case histories are presented for each disturbance in chronological order. The case histories contain brief discussions of the following features; development, features of the track; rainfall, flooding, and flood damage; winds and wind damage; and sea, swell, storm surges, and related damage. S.C.W.

N68-30737# Weather Bureau, Washington, D. C.
AN ANNOTATED BIBLIOGRAPHY ON THE CLIMATE OF NEPAL (INCLUDES CLIMATIC MAPS)

Annie E. Grimes Sep. 1967 42 p
(WB/BC-95; AD-670049)

The document lists 106 reports by title and author, and includes descriptive comments concerning the content of these reports. TAB

N68-30738# Weather Bureau, Washington, D. C.
BIBLIOGRAPHY ON THE CLIMATE OF THE SOMALI REPUBLIC
Charles S. Vitale Sep. 1967 60 p
(WB/BC-94; AD-670048)

The document lists reports by title and author, and includes descriptive comments concerning the content of these reports. TAB

N68-30787# Joint Publications Research Service, Washington, D. C.
RESULTS OF TESTS ON ICE-FORMING AND CRYSTALLIZATION AGENTS
1 Aug. 1968 26 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 186, 1966 p 18–37
(JPRS-46050) CFSTI: HC $3.00/MF $0.65

CONTENTS:

1. EFFECT OF ADMIXTURES OF SURFACE ACTIVE SUBSTANCES ON THE EFFECTIVENESS OF ICE-FORMING SOLUTIONS OF PHLOROGLUCINOL, SILVER IODIDES AND LEAD IODIDES T. N. Gromova, N. V. Gliki, and P. N. Krasikov p 1–11 refs (See N68-30788 18-20)

2. EXPERIMENTAL STUDIES OF CRYSTALLIZATION OF SUPERCOOLED CLOUDS BY PYROTECHNICAL COMPOSITIONS CONTAINING SILVER IODIDE AND LEAD IODIDE Yu. P. Sumin p 12–24 refs (See N68-30789 18-20)

N68-30788# Joint Publications Research Service, Washington, D. C.
EFFECT OF ADMIXTURES OF SURFACE-ACTIVE SUBSTANCES ON THE EFFECTIVENESS OF ICE-FORMING SOLUTIONS OF PHLOROGLUCINOL, SILVER IODIDES AND LEAD IODIDES
T. N. Gromova, N. V. Gliki, and P. N. Krasikov *In its* Results of Tests on Ice-Forming and Crystallization Agents 1 Aug. 1968 p 1–11 refs (See N68-30787 18-20)

A description and the results are presented of the laboratory tests on a study of the influence of admixtures of surface active substances (SAS) on the ice forming activity of the solutions during their atomization in supercooled fog. It is shown that the SAS at a concentration of 0.1–1% reduces the freezing temperature of drops of the indicated solutions by 3–7° and promotes a reduction in the yield of ice crystals during the atomization of solutions of AgI, PbI_2 and $C_6H_3(OH)_3$ in fog within the limits of $10–10^3$ times. An attempt has been made to explain the mechanism of the crystallization of supercooled fogs during the effect by dispersed solution on the ice forming substances. Author

N68-30789# Joint Publications Research Service, Washington, D. C.
EXPERIMENTAL STUDIES OF CRYSTALLIZATION OF SUPERCOOLED CLOUDS BY PYROTECHNICAL COMPOSITIONS CONTAINING SILVER IODIDE AND LEAD IODIDE
Yu. P. Sumin *In its* Results of Tests on Ice-Forming and Crystallization Agents 1 Aug. 1968 p 12–24 refs (See N68-30787 18-20)

The results gained from the field tests are presented the crystallizing effects of AgI and PbI_2, sublimated in the pryotechnical compositions S-36 and S-55. The critical values were obtained of the crystallization temperatures for these reagents, and also of the propagation rates of crystallization from a point source. Author

N68-30838# Weather Bureau, Washington, D. C.
SECONDARY BIBLIOGRAPHY ON THE CLIMATE OF ECUADOR
1967 14 p refs
(WB/CB-24; AD-670044)

The document lists 80 reports by title and author, and includes descriptive comments concerning the content of these reports. TAB

N68-30860# Syracuse Univ. Research Corp., N. Y. Special Projects Lab.
CLUTTER (WEATHER) REDUCTION STUDY Final Report, 29 Nov. 1967–16 Feb. 1968
John F. Jureller and Horace W. Meredith Griffiss AFB, N. Y. RADC May 1968 77 p refs
(Contract F30602-68-C-0150)
(SURC-68-1; RADC-TR-68-143; AD-670194)

The study provides information of the wind, rainfall, and cloud moisture conditions which could reasonably be expected in areas of Ground Control Approach (GCA) operation. In conjunction with this information, the effects on microwave signals at S-, C-, and X-band are determined. The basic physical description of scattering due to hydrometers is reviewed and equations are presented for calculating attenuation and back-scatter cross sections Profile plots covering many specific weather situations are provided. These are specifically designed for use in radar applications. Specific GCA type application of this information is provided for several realistic situations. It is found that the magnitude of the clutter return can be sufficient to mask an aircraft at ranges greater than a few kilometers. Methods of clutter reduction and applications of GCA radars to provide real time weather information for flight safety are discussed. Recommendations are made for study of the weather clutter frequency spectrums to provide needed clutter filter design criteria. Author (TAB)

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N68-29707*# Control Data Corp., Minneapolis, Minn. Aerospace Research Dept.
FEASIBILITY STUDY FOR SCANNING CELESTIAL ATTITUDE DETERMINATION SYSTEM SCADS ON THE MP SPACECRAFT Final Report
D. F. Nickel, C. B. Grosch, H. R. Paetznick, R. W. Peterson, and B. D. Vannelli 10 Jun. 1967 261 p refs
(Contract NAS5-9439)
(NASA-CR-95808; RD-2005) CFSTI: HC $3.00/MF $0.65 CSCL 22C

The feasibility of using an electro-optical celestial scanning sensor on board the IMP spacecraft for determination of the spacecraft attitude by utilizing star measurements is discussed. The sensor basically consists of a wide-angle lens with a slit positioned on the focal surface, a photomultiplier detector positioned behind the slit aperture and star signal processing electronics. The sensor, which consists of no moving parts, rotates with the spin stabilized vehicle. After automatic identification of the stars detected, the vehicle attitude is determined by computer solution of the system constraint equations. The study effort was largely devoted to the areas of optical design, electrical design, mechanical design, signal detection analysis, system error analysis, and star identification. A recommended system design is determined. Author

N68-29716# Navy Electronics Lab., San Diego, Calif. Center for Command Control and Communications.
OMEGA SYSTEM SYNCHRONIZATION Research Report, Jun.–Jul. 1967
C. P. Kugel 10 Jan. 1968 21 p
(NELC-1529; AD-669444)

Data collected by the U. S. Naval Observatory in the spring of 1967 shows (a) that the Omega 3-station network was synchronized to within 2 microsec during the period of observation, and (b) that the Omega system is capable of disseminating time and frequency around the globe with an accuracy sufficient for most users. Author (TAB)

N68-29763*# Control Data Corp., Minneapolis, Minn. Aerospace Research Dept.
FEASIBILITY STUDY OF SCANNING CELESTIAL ATTITUDE DETERMINATION SYSTEM SCADS FOR SMALL SCIENTIFIC SPACECRAFT S^3 Final Report
Donald F. Nickel 1 Sep. 1967 292 p refs
(Contract NAS5-10367)
(NASA-CR-95807; RD-2004) CFSTI: HC $3.00/MF $0.65 CSCL 22C

This report describes the feasibility of using an electro–optical celestial scanning sensor on board the Small Scientific Spacecraft (S^3) for determination of the spacecraft attitude by utilizing star measurements. The sensor basically consists of a wide angle lens with a transparent slit positioned on the focal surface, a photomultiplier detector positioned behind the slit aperture and star signal processing electronics. For a spin stabilized S^3 vehicle, the sensor rotates with the vehicle. For non-spinning vehicles, the slit is rotated by a synchronous motor. After automatic identification of the stars detected, the vehicle attitude is determined by computer solution of the system constraint equations. The study effort was largely devoted to the areas of optical design, electrical design, signal detection analysis, evaluation of system operational constraints, and system error analysis. Standardized sensor designs were recommended for application to all S^3 orbital configurations. Author

N68-30126*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THE ORBITAL RECOVERY PROBLEM. PART 1: AN ANALYSIS TECHNIQUE FOR RAPID DETERMINATION OF RETURN OPPORTUNITIES AND LATERAL-RANGE REQUIREMENTS FOR RECALL TO RECOVERY NETWORKS
Paul F. Holloway and E. Brain Pritchard Washington Jun. 1967 43 p refs
(NASA-TR-R-259) CFSTI: HC $3.00/MF $0.65 CSCL 17G

An analysis technique has been developed which makes possible a rapid, accurate solution of the orbital return problem in terms of the determination of recall opportunities and the lateral range requirements associated with these opportunities for the recovery of spacecraft. The methods of application of the analysis technique through an analytical-computer solution, a computer-graphical solution, and a slide-rule solution are discussed. The technique of analysis may be applied to the problem of return from any orbit inclination to any point or number of points on earth. In addition, the technique allows consideration of return from circular or elliptical orbits with any period. Although the analytical-computer solution may be costly in terms of machine time, the computer-graphical solution is shown to be a practical method of obtaining rapid, economical results for a large number of constraints without adding any appreciable inaccuracy to the solution. Examples of the application of the computer-graphical solution are presented for return from circular orbits having periods of 1.5 and 10 hours and from an elliptical orbit with a period of 2 hours and apogee and perigee distances of 5165 and 3600 nautical miles, respectively. Author

N68-30273# Federal Aviation Administration, Atlantic City, N. J. National Aviation Facilities Experimental Center.
DEVELOPMENT AND APPLICATION OF A TERMINAL SPACING SYSTEM Final Report
Donald A. Martin and Francis M. Willett, Jr. Aug. 1968 67 p
(NA-68-25; RD-68-16)

Results are presented on laboratory and field tests of a NAFEC-developed computer system which provided aircraft rate control and spacing assistance to the air traffic controllers in a terminal area. A general purpose digital computer was used to provide heading, speed and turn information, in symbolic and numeric form, on an ASR-4 radar display used by the final approach controller. Additionally, in input/output device at the flight data location indicated which aircraft should depart which outer fix at a given time, in order to establish and maintain a consistent, first-come, first-served traffic flow in the final spacing area (metering). Initial testing was conducted at NAFEC. The system was subsequently relocated to the J.F. Kennedy Terminal Radar Control (TRACON) for further evaluation in an operational environment. In a comparison with the manual control system, use of the final spacing function of the computer system resulted in more consistent and accurate landing intervals which would proportionately increase the arrival rate. However, the computer system as configured and installed was not favorably accepted by the controllers due to an increase in workload. Author

N68-30285# ARINC Research Corp., Washington, D. C.
JET-FLIGHT EVALUATION OF INERTIAL NAVIGATION OPERATIONS, VOLUME 1 Final Report
Jul. 1968 192 p Prepared jointly with United Air Lines, Inc. and prepared for Sperry Gyroscope Co., Great Neck, N. Y.
(Contract FA-67-WA-1723)
(FAA-RD-68-36; Publ.-558-01-1-879)

The results of a jet-flight evaluation of Inertial Navigation System (INS) performance in the commercial-airline operational environment, both domestic and overwater, were described. Evaluation objectives included (1) assessment of the compatibility of inertial techniques with the present Air Traffic Control (ATC) System, (2) determination of the relative accuracy of inertial navigation as compared with VOR/DME navigation, (3) assessment of inertial-system updating requirements, (4) evaluation of pilot-workload effects, and (5) investigation of several other aspects of the use of an inertial system in the commercial-airline environment. The accomplishment of these objectives required the joint effort of the Federal Aviation Administration, the Sperry Gyroscope Division of the Sperry Rand Corporation, United Air Lines, and ARINC Research Corporation. INS relative accuracy, performance, autopilot-coupled operation, and reliability are discussed, and INS parameters are compared with navigation-aid parameters. Conclusions and recommendations concerning the use of inertial navigation systems in the domestic and overwater commercial-airline environments are also presented. Author

N68-30297*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
A PATHFINDING ALGORITHM FOR A MYOPIC ROBOT
Larry Y. Lim 1 Aug. 1968 26 p refs
(Contract NAS7-100)
(NASA-CR-95878; JPL-TR-32-1288) CFSTI: HC $3.00/MF $0.65 CSCL 17G

A pathfinding algorithm has been developed for an autonomous myopic roving vehicle. With the assumption that a path exists between two points, two propositions are proved. Proposition 1 is concerned with no obstacles and proposition 2 is concerned with at least one obstacle. Various conditions are established and terms defined. Three algorithms, necessary to direct the robot, are main, left scan, and right scan. The decisions for the navigation, control, and obstacle avoidance of the rover are based mainly on myopic (local) information of the terrain. The use of Gaussian density

functions to simulate topography is considered to be novel. A FORTRAN IV computer program was written to implement the pathfinding algorithm, and the results of the computer-program runs were satisfactory. Author

N68-30380# Federal Aviation Administration, Atlantic City, N. J. National Aviation Facilities Experimental Center.
AN EVALUATION OF AN ALL-WEATHER LANDING PANEL DISPLAY Final Report
Robert H. Pursel Aug. 1968 65 p ref
(NA-68-9; RD-68-21)

A flight test evaluation of an instrument panel display for monitoring automatic landings was performed. A DC-7 aircraft equipped with a single-channel Automatic Landing System was utilized. Over 700 automatic approaches were conducted under simulated Category III conditions. Intentional ILS path deviations or sensor failures were inserted on many of these approaches. The results of this test program have been very beneficial in that solutions to problems encountered with the particular equipments have led to improved instrument layout and design. Valuable inputs also have been provided to all-weather landing system developments now in the test and evaluation stage. Author

N68-30447# Wilcox Electric Co., Inc., Kansas City, Mo.
DEVELOPMENT OF LOCALIZER AND GLIDE SLOPE CLEARANCE TRANSMITTERS Final Report
K. E. Hawthorne Mar. 1968 38 p
(Contract FA-65-WA-1270)
(FAA-RD-68-18)

The design, development, and testing of prototype units of localizer and glide slope clearance transmitters are described. VHF signals are generated by a voltage-controlled crystal oscillator and doubler. An existing design power amplifier, with a unique low level modulation technique and over-current protection, was used. In the glide slope clearance transmitter, a tripler, with helical resonator bandpass filter, is used to obtain the required uhf signal. A constant impedance power divider is used to adjust output power level in the glide slope unit, but this is not practical for the localizer unit, so a technique of potentiometric scaling of ac and dc analogs of modulation and carrier levels was developed. In addition to final performance testing, a feasibility test of afc lock-in of the clearance signals with modulated reference signal was conducted. Author

N68-30571*# Sperry Rand Corp., St. Paul, Minn. Univac Federal Systems Div.
STRAPDOWN CALIBRATION AND ALIGNMENT STUDY. VOLUME 1: DEVELOPMENT DOCUMENT Final Report
D. M. Garmer, E. J. Farrell, S. Kau, and F. N. Bailey [1968] 218 p refs
(Contract NAS12-577)
(NASA-CR-86077) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Calibration and alignment techniques are detailed for a strapdown inertial sensing unit (ISU), and specific solutions to the various tasks involved are included. Mirror, level, and gyrocompass techniques are included. Calibration was accomplished by measuring specific input environments and using the relationship of known kinematic input to sensor outputs so that constants of the sensor models could be determined. Inputs were from the earth angular rate, the normal reaction force of gravity, and the angular rotation imposed by a test fixture. Equations were developed for the calibration techniques, and attention was given to the various choices of calibration environments. Preprocessing computations, environment and sensor noise models, and estimations of gravity in level alignment as well as gravity and earth rate in gyrocompass are discussed. Alignment matrices were calculated from estimations of gravity, earth rate, and optical angles. Mathematical models are detailed for the vibrating string accelerometer and the gyroscope, alternate forms of Q matrices are given, and the laboratory computer that interfaces with the ISU is described. M.W.R.

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N68-29759 Iowa State Univ. of Science and Technology, Ames.
OPTIMUM CONSTRAINED CONTROL OF AN UNSTEADY-STATE TUBULAR REACTOR
Chao-Hsiung Tsai (Ph.D. Thesis) 1967 166 p
Available from Univ. Microfilms: HC $7.40/MF $3.00 Order No. 67-13007

A mathematical study was made of optimal control of unsteady-state, plug-flow tubular reactors and heat exchangers. An extension of the Maximum Principle was developed for this work. Control variables are constrained not only by the usual magnitude constraints, but also by requiring these variables, such as reactor temperature or heating medium temperature, to be uniform throughout finite zones at any instant of time. Results of the study include optimal temperature strategies and corresponding yields for four different reaction systems, and a case study of a heat exchanger. The optimal heat exchanger control is deliberately periodic, in the absence of continuing disturbances. The optimal reactor temperature strategies are quite different in detail one from another. But in general more zones usually permit better control and three zones usually approaches closely to the many-zone or "ideal" reactor. Dissert. Abstr.

N68-29886*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NAC: NEUTRON ACTIVATION CODE
Suzanne T. Weinstein Washington 1968 49 p refs
(NASA-TM-X-52460) CFSTI: $3.00 CSCL 18F

Neutron activation code (NAC) is a computer code designed to predict the neutron induced gamma ray radioactivity for a wide variety of composite materials. This code is a subset of the NAP code, and the code output has been altered to provide convenient analysis by experimenters. The NAC output includes the input data, a list of all reactions for each constituent element, and the end of irradiation disintegration rates for each reaction. The code also compiles a product isotope inventory containing the isotope name, the disintegration rate, the gamma-ray source strength, and the absorbed dose rate at 1 meter from an unshielded point source. The induced activity is calculated as a function of irradiation and decay times; the effect of cyclic irradiation can also be calculated. Author

N68-29921*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NUCLEAR REACTOR SPACE POWER CONVERSION SYSTEMS
Roger F. Mather 1968 13 p Presented at Triann. Power Conf., Chicago, 8–10 Apr. 1968; Sponsored by AFOSR
(NASA-TM-X-52472) CFSTI: HC $3.00/MF $0.65 CSCL 18L

The principal systems now being investigated for converting heat from advanced nuclear reactors to electrical power for manned and unmanned spacecraft are discussed. These power conver-

sion systems are the Rankine and Brayton turboalternator, magnetohydrodynamic, and thermionic. The basic operating principles and development status are described for each of these systems. System efficiencies, applicable power levels, development problems and other characteristics are briefly reviewed. Author

N68-29922*# Aztec School of Languages, Inc., Acton, Mass. Research Translation Div.
SHIELDING [ABSCHIRMUNG]
Washington NASA Jul. 1968 11 p refs Transl. into ENGLISH from Tech. Hochschule Stuttgart Wiss. Ber. BMwF-FBK-67-46 (Stuttgart), May 1967 p 144-159 For GERMAN Text see N67-37907
(Contract NASw-1692)
(NASA-TT-F-11651) CFSTI: $3.00 CSCL 18F

The problem of achieving minimum radiation-shield weight while ensuring adequate protection of the payload is discussed with respect to the problem of using a nuclear reactor as a source of electrical power aboard spacecraft. Only an increase in the ratio of the reactor core height to its diameter can permit reduction of the shield volume; the H/D ratio of 1.05 used thus far is unacceptably small. Author

N68-29950*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NEUTRONIC EFFECTS ON MODERATOR INSERTION IN FAST-SPECTRUM REACTORS
Wendell Mayo Washington Aug. 1968 18 p refs
(NASA-TM-X-1614) CFSTI: HC $3.00/MF $0.65 CSCL 18I

A study of the effects of insertion of yttrium hydride into fast-spectrum reactors was conducted. Large, negative moderator temperature coefficients of reactivity that became more negative with increasing moderation were found. Partial or primary reactor control could be based on this temperature coefficient. An increase in the mean prompt-neutron lifetime and a decrease in the positive reactivity coefficients of volumetric compression were observed when moderator was added. Moderator addition, however, increases the core size and results in larger fast-neutron fluxes in the reflector, causing increased shield weight for compact nuclear spacepower systems. Author

N68-29973*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NERVA XE-1 CONTROL DRUM ACTUATOR LOW-TEMPERATURE HYDROGEN TEST PROGRAM
David J. Robinson Washington Jun. 1968 39 p refs
(NASA-TM-X-52465) CFSTI: HC $3.00/MF $0.65 CSCL 18I

To gain further confidence in actuator performance in the 30 to 80°K temperature range, a test program using gaseous hydrogen was conducted. For the test program, actuator performance was measured in terms of its ability to function in a closed loop positioning system. The results showed that the actuator tested, while in continuous operation, performed satisfactorily when subjected to step changes in temperature from ambient to the 30 to 80°K range. The step changes in temperature include lowering both the coolant gas temperature while holding the drive gas at ambient temperature, and lowering both the drive and coolant gas temperatures. The test program also showed, for the actuator tests, that if the actuator is locked in one position and then subjected to a step change in temperature to the 30 to 80°K range, performance after unlocking is erratic. Author

N68-30055# Comitato Nazional per l'Energia Nucleare, Rome (Italy)
MEASUREMENT OF THE DISTRIBUTION OF SPECIFIC OUTPUT IN SOME MOCK-UPS IRRADIATED IN THE RITMO REACTOR [MISURE DI DISTRIBUZIONE DI POTENZA SPECIFICA IN ALCUNI MOCK-UPS IRRAGGIATI NEL REATTORE RITMO]
L. Bozzi 1968 31 p refs In ITALIAN; ENGLISH summary
(CNEN-RT/FI(68)13) CFSTI: HC $3.00/MF $0.65

Irradiations of two series of mock-ups containing respectively 25%-enriched UO_2 rods and natural UO_2-B_2O_3 rods with the same absorption cross-section have been realized in the RITMO Reactor at CNEN, Casaccia. The methods for measuring the specific power generated in the 25%-enriched UO_2 monitors inserted in the rods using different non destructive techniques of post-irradiation analysis are discussed. Author

N68-30125# Phillips Petroleum Co., Idaho Falls, Idaho. Idaho Operations Office.
ENGINEERING AND TEST BRANCH Quarterly Technical Report, Jul.-Sep. 1967
K. A. Dietz, ed. Feb. 1968 44 p refs
(Contract AT(10-1)-205)
(IDO-17241) CFSTI: HC $3.00/MF $0.65

Parametric studies of the nuclear design of the LOFT core were conducted to determine the effect changes in control rod and fuel pin configurations have on the core nuclear characteristics. Nuclear characteristics of open-lattice control rods were investigated to ascertain the effects of varying poison pin spacings. Reactor cores having the thermal-hydraulic characteristics associated with PWR designs permitting free radial flow were studied. Preliminary results of these studies indicate that a modified LOFT-ECCS core can be adequately controlled with open-lattice cruciform control rods. Fuel pin spacings and diameters, fuel enrichments, and enrichment zones remain to be specified. Three-dimensional power distributions and critical rod positions were calculated for the LOFT core. The power distributions were for 100, 400, and 800 hours of operation at 50 MW. Critical control rod positions obtained using the TNT02 computer program agreed with those obtained through the RZ-TURBO program. Author (NSA)

N68-30142# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATIONS OF EPITHERMAL NEUTRON SPECTRA BY MEANS OF THIN RESONANCE FOILS [UNTERSUCHUNG EPITHERMISCHER NEUTRONENSPEKTREN MIT DUNNEN RESONANZSONDEN]
P. Schumann and D. Albert 12 Oct. 1967 13 p refs Transl. into ENGLISH from Kernenergie (Dresden), no. 2, 1965 p 88-92
(FTD-HT-23-821-67; AD-669298)

Using the resonance detectors 115In, Au, 152Sm, 186W, La, Mn, and 98Mo epithermal neutron spectra were studied at various points of the RFR core and in the vertical channel 2 of the RFR thermal column in the energy range 1 to 500 ev with respect to their deviations from 1/E behavior. In an air-filled channel at the periphery of the core, alpha = 0.98 + or - 0.02 was found by an absolute determination. The other measurements have been referred to this value. In the vertical channel 2 of the RFR thermal column (distance from the core boundary 60 cm), alpha = 1.04 + or - 0.02. Author (TAB)

N68-30163# Oak Ridge National Lab., Tenn. Isotopes Development Center.
REACTOR PRODUCTION AND CHARACTERIZATION OF CADMIUM-109
R. E. Lewis and T. A. Butler May 1968 13 p refs
(Contract W-7405-ENG-26)
(ORNL-4247) CFSTI: HC $3.00/MF $0.65

Two methods for production of ^{109}Cd were examined: neutron irradiation of ^{108}Cd and natural silver. Effective neutron capture cross sections were determined to be 1.1 and 700 barns

for ^{108}Cd and ^{109}Cd nuclides, respectively. The specific activity and the purity of the ^{109}Cd products obtained by both methods of preparation are compared. The achievable specific activity of ^{109}Cd is greater when enriched ^{108}Cd is used as target material; however, traces of ^{115m}Cd produced from ^{114}Cd in the target material limit the usefulness of the product. Cadmium-109 prepared from silver is free of other radionuclides of cadmium. The rate of production of ^{109}Cd from enriched ^{108}Cd and from natural silver and the chemical recovery and purification processes for each method of production are described. Author (NSA)

N68-30184# Reactor Centrum Nederland, Petten.
ECLIPSE: DIGITAL NEUTRON TRANSPORT PROGRAMME FOR TREATING THE NON-UNIFORM BURN-UP OF BURNABLE POISON PARTICLES INCORPORATED IN REACTOR FUEL
W. A. Raaijmakers Brussels EURATOM May 1968 87 p refs
(Contract EURATOM-007-61-6 PNIN)
(EUR-3930.E) CFSTI: HC$3.00/MF$0.65

This report presents an outline of the physics and mathematics of a computer program that calculates two-group neutron fluxes and associated burn-up of poison atoms within a spherical burnable poison particle. The problem consists, merely, in evaluating the neutron fluxes in three spherically concentric regions, the poison sphere being located at the centre of the system whereas the two surrounding regions may be, respectively, fuel and moderator or a carrier material and/or moderator. Subsequently, a time-step is taken during which some of the poison and fuel atoms will be consumed and, eventually, formed whilst also the total neutron absorption rate by the particle is computed. During the time-step the neutron fluxes are assumed not to change. With the new concentrations of poison and fuel atoms the neutron fluxes for the following time-step are determined. This process is continued for a specific number of time-steps giving as a result the total neutron absorption rate by the particle as a function of time or as a function of the integrated flux-time (i.e. irradiation) in the neighbouring region containing fuel or the carrier material. Author

N68-30185# Etablissements Kuhlmann, Paris (France).
DECONTAMINATION OF EFFLUENTS BY MEANS OF ZEOLITES [DECONTAMINATION DES EFFLUENTS PAR LES ZEOLITHES]
J.-L. Verot, J.-M. Blum, R. Sarfati, J. Dagnes, and Y. Cassin Brussels EURATOM May 1968 80 p refs In FRENCH; ENGLISH summary
(Contract EURATOM-003-65-3 WASF)
(EUR-3452.F, V. 2) CFSTI: HC$3.00/MF$0.65

The systematic research carried out previously on synthetic effluents was supplemented by tests on real effluents. These tests showed that the results were unchanged and also that the concentration factors obtained were 3 to 3.5 times as high as in conventional processing. In order to improve the decontaminating properties of zeolites in relation to strontium, a new zeolite and a method of synthesizing it were developed. The encouraging results obtained have still to be checked in effluents of varying concentrations. A micropilot unit was constructed for testing the substances studied continuously. The influence of various parameters—pH value, flow, load, number of stages, etc. was analyzed in both synthetic and real effluents. It was found that in four or six stages of identical processing methods it was possible to reduce the simulated activity of an effluent. A method of treating loaded zeolites was also studied—cement, bitumen, fusion. The last two methods are the most advantageous. The volume reduction factors are very high, namely 250 and 1000 respectively. In addition, orientation tests concerning the fixation of certain critical radioelements (Ce, Co, Zn, Ra) by zeolites were carried out. Author

N68-30203# Reactor Centrum Nederland, Petten.
COMPARATIVE STUDY OF THE NON-UNIFORM BURN-UP OF BURNABLE POISON PARTICLES USING ANALOGUE AND DIGITAL COMPUTER TECHNIQUES AND A NEW DEFINITION OF THE SELF-SHIELDING FACTOR
W. A. Raaijmakers Brussels EURATOM May 1968 43 p refs
(Contract EURATOM-007-61-6 PNIN)
(EUR-3931.E) CFSTI: HC$3.00/MF$0.65

A comparative study has been undertaken on the behaviour of lumped absorbers (burnable poison particles) under neutron irradiation pursuing two different ways. One uses a rather simple analog model, the other a more sophisticated digital computer program. Upon comparison of the results it is possible to conclude that also the first method adequately predicts the absorption characteristics provided the adjustment of the analog model to some recent developments pertaining to the definition of the self-shielding factor. Author

N68-30215# Aktiebolaget Atomenergi, Stockholm (Sweden).
LINEAR DYNAMICS MODEL FOR STEAM COOLED FAST POWER REACTORS
Heinz Vollmer Apr. 1968 41 p refs Submitted for publication
(AE-316) CFSTI: HC$3.00/MF$0.65

A linear analytical dynamic model is developed for steam cooled fast power reactors. All main components of such a plant are investigated on a general though relatively simple basis. The model is distributed in those parts concerning the core but lumped as to the external plant components. Coolant is considered as compressible and treated by the actual steam law. Combined use of analogue and digital computer seems most attractive. Author (ESRO)

N68-30274# European Atomic Energy Community, Ispra (Italy). Reactor Physics Dept.
CALCULATION OF THE ABSORPTION AND FISSION RESONANCE INTEGRALS OF U-235 BY A FITTING PROCEDURE
W. de Haan and S. Stramaccia Brussels Jun. 1968 35 p refs
(EUR-3936.E) CFSTI: HC$3.00/MF$0.65

A fitting procedure has been set-up to evaluate quickly the resonance integrals of fissile nuclides in multigroup neutron calculation models. For this purpose, the results of resonance integrals calculated by the refined numerical Nordheim method (ZUT and TUZ codes) are fitted into a formula based on the classical resonance theory, thus determining for each nuclide and type of event a set of parameters (three) dealing with the energy group considered. The U-235 values are reported for the energy group scheme of the lattice code PINOCCHIO. Author

N68-30288# Centro Informazioni Studi Esperienze, Milan (Italy).
THE "PROCELLA" METHOD FOR HEAVY WATER LATTICES
R. Bonalumi, F. Palazzi, and G. Pierini Brussels EURATOM Jun. 1968 286 p refs
(Contract EURATOM-008-65-1 NTRI)
(UR-3921.E) CFSTI: HC$3.00/MF$0.65

The method described here regards in principle D_2O lattices. It is based on simplified models, so as to require no adjusted constants, while calculations are at a time rather accurate and very rapid. The method follows a 4-group breakdown on neutron spectrum (fast, resonance, epithermal and thermal) to yield corresponding lattice diffusion parameters: fissioning and absorption occur in all groups; extensive use is made of properly developed first-collision probability methods. Main original features are: (1) an original definition of the resonance absorption effective surface; (2) an analytical calculation of the U^{238} resonance escape probability allowing for high energy flux peaking and using a simplified

absorption cross section which reproduces Hellstrand's resonance integrals; (3) a very special, analytical treatment of thermalization in the fuel element, starting from a Westcott-like flux in the moderator; (4) epithermal cross sections including disadvantage and shielding factors, the latter ones being obtained by a generalized equivalence theorem for resonance capture. The method is embodied in the PROCELLA code, written for the IBM 7040 digital computer: each problem takes no more than 10 sec, thus making this method very attractive for long-term reactivity studies. Author

N68-30289# European Atomic Energy Community, Ispra (Italy). Engineering Dept.
NON-DESTRUCTIVE AND DESTRUCTIVE TESTING OF REACTOR PRESSURE TUBES IN SAP
C. Albertini, M. Montagnani, and P. Weltevreden Brussels May 1968 45 p refs Presented at the 4th Congr. on Mater. Testing, Budapest, 11–14 Oct. 1967
(EUR-3929.E) CFSTI: HC$3.00/MF$0.65

One of the basic components of the organic cooled, heavy water moderated reactor type is the pressure tube assembly. In the hot pressure tube version the pressure tube operates on reactor coolant temperature and must withstand the coolant pressure over the entire life-time of the reactor. In order to test this assembly under operating conditions, a certain number of these are mounted in a test reactor specifically designed for this purpose. Before mounting the assemblies, a selection of pressure tubes delivered by the manufacturer has been performed on the basis of non-destructive and destructive testing. The non-destructive testing included: metrology, endoscopy, fluorescent liquid checking, ultrasonic testing, X-ray testing. The destructive testing included: tensile testing at R.T., tensile testing at 420°C, chemical and activation analysis, residual stresses, creep testing. Special attention has been paid to the latter item and creep tests on specimen cut from the tube wall as well as creep tests on complete tube sections have been performed. A statistical evaluation of creep data resulted in preliminary admissible stress levels as a function of temperature. Author

N68-30302# Southwest Research Inst., San Antonio, Tex.
INFLUENCE OF NEUTRON IRRADIATION ON THE PROPERTIES OF STEELS AND WELDS TYPICAL OF THE ERR PRESSURE VESSEL AFTER TWO POWER YEARS OPERATION
D. R. Ireland and E. B. Norris Mar. 1968 103 p refs
(Contract AT(11-1)-1228)
(SWRI-1228-P-9-15) CFSTI: HC$3.00/MF$0.65

As a part of the Elk River Reactor (ERR) Surveillance Program, a study has been made of the effects of neutron irradiation on the tensile, impact, and fatigue properties of steels and welds typical of those in the ERR pressure vessel. The test specimens utilized have been exposed to neutron fluence that is equivalent to what the vessel is expected to have received after 4-1/2 full power years of operation. The results of tests on irradiated tensile and fatigue specimens are compared with those from the previous surveillance specimens and with the unirradiated properties. Charpy V-notch impact curves were determined for irradiated materials so that the shift in the frature transition temperature of the ERR pressure vessel could be estimated. The results of these tests are reviewed with respect to the estimated operating conditions (temperature, time, and fluence) of the ERR pressure vessel. Author (NSA)

N68-30319# Bhabha Atomic Research Centre, Bombay (India).
UTILISATION OF A RESEARCH REACTOR—TEN YEARS OF APSARA
[1967] 82 p refs
CFSTI: HC$3.00/MF$0.65

Nuclear physics activity in Aspara, India over the past ten years is reviewed. The design, development, and construction of a reactor and its instrumentation is recounted. Investigations in neutron physics, nuclear fission, nuclear spectroscopy, irradiation of compounds, agricultural and biological applications, isotope production, activation analysis, and health are highlighted. D.H.B.

N68-30343# Harvard Air Cleaning Lab., Cambridge, Mass.
HARVARD AIR CLEANING LABORATORY Semiannual Progress Report, 1 Sep. 1967–1 Mar. 1968
M. W. First, F. J. Viles, Jr., P. C. Reist, E. A. Bulba, M. J. O'Brien et al Apr. 1968 89 p refs
(Contract AT(30-1)-841)
(NYO-841-12) CFSTI: HC$3.00/MF$0.65

Research on air cleaning processes is reported. The major accomplishments were: redesign of a sodium aerosol recirculating system to provide data on the deposition of sodium on the walls of pipes; completion of tests on the use of foams for removing iodine and methyl iodide from reactor containment vessel atmospheres; investigation of copper beads as a filter bed material for removing (and subsequently measuring) iodine removed from ventilating systems of power reactors; initiation of laboratory efforts to evaluate a theory on krypton separation by electrostatic diffusion; construction of a 75 ft^3 steel containment tank capable of retaining air and steam pressures up to 45 psig for cleanup systems; and planning an air cleaning conference on the treatment of airborne radioactive wastes. NSA

N68-30369*# Techtran Corp., Glen Burnie, Md.
THE SPHERICAL PILE REACTOR AS THERMAL THORIUM BREEDER. 1. GRAPHITE AS MODERATOR [DER KUGEL-HAUFENREAKTOR ALS THERMISCHER THIORIUMBRUTER 1. GRAPHIT ALS MODERATOR]
S. Brandes Washington NASA May 1968 34 p refs Transl. into ENGLISH from the German Report
(Contract NASw-1695)
(NASA-TT-F-11705) CFSTI: HC$3.00/MF$0.65 CSCL 18I

The breeder characteristics of a graphite-moderated high temperature reactor of the spherical pile type for the thorium 232-uranium 233 breeder cycle are studied, investigation being conducted from the standpoint of minimum doubling times. Economic considerations are ignored. The BABS program (a burn-up program for a thorium converter developed by the DRAGON project), expanded and improved for the design of breeder reactors (GABS program) was employed for calculations. Author

N68-30377# European Atomic Energy Community, Ispra (Italy). Reactor Physics Dept.
USE OF ANALOG COMPUTER FOR POWER RECIPROCAL SPECTRUM AND SPECTRUM MEASUREMENT [APPLICAZIONE DI UN CALCOLATORE ANALOGICO ALLA MISURA DI SPETTRO E SPETTRO MUTUO DI POTENZA]
A. Garroni and A. Lucia Brussels May 1968 36 p refs In ITALIAN; ENGLISH summary
(EUR-3925.I) CFSTI: HC$3.00/MF$0.65

This paper discusses a method of power and cross-power density spectra estimation by analog computer. The computing errors, either statistical or technological, are analyzed. Author

N68-30382# Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.
FRACTURE MECHANICS EVALUATION OF REACTOR VESSEL STEELS Quarterly Progress Report, Period Ending 31 Mar. 1968
L. F. Cochrun Apr. 1968 12 p refs
(Contract AT(30-1)-3877)
(EURAEC-2007; WCAP-3677-7) CFSTI: HC$3.00/MF$0.65

An experimental program is being performed to develop and evaluate a fracture mechanics approach using modified Wedge Opening Loading specimens. Progress under the Irradiation and Analysis, and the Pre-Irradiation Testing tasks of the program are reported. The layout for sectioning and the kind of specimens taken from the 12-inch thick plate of SA-533 Grade B Class I steel, are given. NSA

N68-30433# Bhabha Atomic Research Centre, Bombay (India).
PREPARATION OF HIGH DENSITY URANIUM MONOCARBIDE (UC) PELLETS BY REACTION SINTERING OF A MIXTURE OF URANIUM DICARBIDE AND URANIUM METAL POWDERS
V. K. Moorthy and B. D. Zope 1967 13 p refs
(BARC-319) CFSTI: HC $3.00/MF $0.65

Attempts were made to prepare single phase UC pellets of high density by reaction sintering of pellets made from stoichiometric mixture of uranium dicarbide and uranium metal powder. It was found that the formation of monocarbide starts at 1000°C and is completed at 1300°C. This process has the additional advantage that high density can be attained even in the green state. Pellets of a density of about 97% theoretical were obtained by pressing the stoichiometric mixture at 800° to 1200°C. The conversion to UC was brought to completion by subsequent vacuum sintering at about 1400°C. Author

N68-30452# Bettis Atomic Power Lab., Pittsburgh, Pa.
A MICROSAMPLING TECHNIQUE FOR THE PREPARATION OF HIGHLY RADIOACTIVE MATERIALS FOR ANALYSIS IN UNSHIELDED MICROPROBES
R. Burton and C. E. Campbell Apr. 1968 25 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-TM-685) CFSTI: HC $3.00/MF $0.65

A new microsampling technique has been developed to permit the remote sampling of minute specimens from any preselected region in highly radioactive metallic specimens with an accuracy unattainable by existing techniques. The design and operation of a newly developed, remotely operable punching tool is described. A detailed description of the operations involved in the preparation of metallic and ceramic types of irradiated materials is given. Author (NSA)

N68-30472# Japan Atomic Energy Research Inst., Ibaraki.
MERITS OF THE NONLINEAR-SCALE PERIOD METER IN COMPROMISING SCRAM-DELAY AND FLUCTUATION
Tomozo Furukawa (Hokkaido Univ.) and Naoaki Wakayama Feb. 1968 8 p ref Transl. into ENGLISH from Nippon Genshiryoku Gakkaishi (Tokyo), v. 8, no. 9, Sep. 1966 p 486–489
(NSJ-TR-101) CFSTI: HC $3.00/MF $0.65

A description is given of the relationship between the fluctuation caused by the process of detection of the neutron flux during the normal operation and the response or delay time to the trip action of the excessively short period in the nonlinear period meter, which has a larger gain in the range of normal period for starting-up the reactor and a smaller gain in the range of abnormally short period. This type of period meter is shown to be convenient for the operator in reading the scale in the range of normal operation. In addition it has an advantage over the conventional period meter in the compromise of fluctuation and trip-delay. Author

N68-30474# Bhabha Atomic Research Centre, Bombay (India).
DEVELOPMENT OF HIGH DENSITY AND CONTROLLED MICROSTRUCTURE IN SINTERED URANIA PELLETS
V. K. Moorthy and N. S. Anandan 1967 52 p refs
(BARC-314) CFSTI: HC $3.00/MF $0.65

As assessment is made of the relations between powder properties, sintering treatments, and the densification and microstructure development in urania pellets. Urania powders were prepared from ammonium diuranate by decomposition and reduction at various temperatures, namely, 400°, 600°, 900°, 1200° and 1500°C. Pellets prepared from these powders were sintered at temperatures in the range of 1200° to 1700°C with different soaking periods. The influence of sintering temperatures, soaking periods at different temperatures, intermediate soaks at varying time periods at various temperatures, reheating of the prepared sintered pellets, and rates of heating during sintering on the density and microstructure development of pellets was studied. Results show that urania pellets of specified density and grain development can be prepared by first attempting to achieve densification and then continuing the thermal treatments to attain the desired grain size and microstructure. Author

N68-30475# Bhabha Atomic Research Centre, Bombay (India).
ANGULAR ANISOTROPY OF FISSION FRAGMENTS IN TERNARY FISSION OF U^{235} INDUCED BY 3-MEV NEUTRONS
D. M. Nadkarni 1967 33 p refs
(BARC-318) CFSTI: HC $3.00/MF $0.65

The values of angular anisotropy of fragments in binary and ternary fission of U^{235} induced by 3 MeV neutrons have been determined with two independent methods. In the first method fission fragments and long-range alpha particles were detected with a gridded ionization chamber and a CaI crystal respectively; in the second method semiconductor detectors were used to detect fission fragments and long-range alpha particles. The values of $[N(0°)/N(90°)]$ for cases of binary and ternary fissions are found to be different. The probability for emission of long-range alpha particles in 3 MeV neutron-induced fission is found to be lower than that in thermal neutron-induced fission. A decrease in the average single fragment kinetic energy of ternary fragments compared to that of binary fragments is observed in 3 MeV neutron-induced fission similar to that in thermal neutron fission. It is shown that on the basis of the angular distribution of long-range alpha particles and ternary fragments it is possible to learn at what stage in the fission process the long-range alpha particles are emitted. Author

N68-30516*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CHARACTERISTICS OF A SPACE-POWER NUCLEAR REACTOR WITH CONSIDERATIONS FOR VENTING OR CONTAINING GASEOUS FISSION PRODUCTS
John V. Miller Washington Aug. 1968 57 p refs
(NASA-TM-X-1631) CFSTI: HC $3.00/MF $0.65 CSCL 18L

A study of a fast spectrum, liquid metal cooled reactor in which the gaseous fission products were either completely vented, completely contained, or partially vented from the fuel element, was performed. Although several areas were found in which insufficient data are currently available to accurately analyze the problem, the characteristic behavior of the various concepts was determined using fuel temperature, cladding strain, and nuclear criticality as limiting conditions. The analysis shows that the completely vented reactor is generally smaller than the other concepts. This size advantage decreases as the strength of the cladding increases and as the allowable fuel temperature decreases. Author

N68-30575# Cekmece Nuclear Research Center, Istanbul (Turkey).
REACTOR PHYSICS PARAMETER (ρ^{28}) MEASUREMENTS IN THE SLIGHTLY ENRICHED WATER MODERATED LATTICES AND ITS RELATION WITH INITIAL CONVERSION RATIO

Cetin Ertek (Ph.D. Thesis—Istanbul Univ.) [1967] 138 p refs
(CNAEM-47) CFSTI: HC $3.00/MF $0.65

Measurements related to reactor physics parameter were made in two light water lattices. The two lattices studied consisted of 0.6-inch-diameter, 1.43% enriched uranium fuel rods arranged in triangular arrays with water to uranium ratios, 2:1 and 3:1. The following quantity is measured in each of the two lattices studied: The ratio of epicadmium U^{238} capture rate in the fuel rod to subcadmium U^{238} capture rate in the fuel rod (ρ^{28}). In order to measure this parameter, several techniques are developed including a new chemical separation and the results are compared with the other existing methods. The experimental results are compared with theoretical results obtained from the computer programs of R. L. Hellens and H. C. Honeck of Brookhaven National Laboratory for the same lattices. Author

N68-30590# Japan Atomic Energy Research Inst., Tokyo.
USES OF PLUTONIUM FUEL IN PRESSURE TUBE-TYPE, HEAVY-WATER MODERATED THERMAL REACTORS
Sigeru Yasukawa and Ryuiti Shindo Dec. 1967 7 p refs
(JAERI-1154) CFSTI: HC $3.00/MF $0.65

Since 1962, the feasibility study of the uses of various nuclear fuels has been performed for pressure tube-type heavy water-moderated thermal reactors. This study started with the analysis of the use of uranium in heavy water-moderated thermal reactors from the standpoint of the core design. Then, the ways of using plutonium fuel in the same type were investigated by using WATCH-TOWER, FLARE, and BOLERO codes, including: (1) direct substitution of the plutonium from light water reactors or magnox reactors, (2) recycle use of the plutonium from heavy water-moderated reactors, (3) plutonium self-sustaining cycle and (4) plutonium phoenix fuel. From these, the followings are concluded: (1) In direct substitution of plutonium, somewhat depleted plutonium is more suited in the core design than the plutonium from magnox reactors or light water reactors, because the increase in the initial reactivity due to large plutonium absorption cross section must be prevented. (2) In plutonium self-sustaining cycle, the fuel burnup of about 15,000 ≈ 20,000 MWD/T would be expected from natural uranium, and the positive void reactivity which always happen in the lattices is greatly reduced, and the latter property gives some margins to burnout heat flux. (3) Furthermore, it may be concluded from the fuel cycle analysis that the plutonium self-sustaining cycle is equivalent to use slightly enriched uranium (about 1.0 atomic percent). From the above, it may be concluded that the use of plutonium in heavy water-moderated reactors is feasible technologically and advantageous economically. Author

N68-30676# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
PULSE INSTALLATION FOR THE CONTROL OF REACTORS [ENSEMBLE A IMPULSIONS POUR LES CONTROLE DES REACTEURS]
J. Buisson and J. Garau 5 Aug. 1966 30 p In FRENCH Presented at the 13th Ann. Nucl. Sci. Symp., Boston, 19–20 Oct. 1966
(CONF-661020-18)

An installation to process the pulses delivered by fission chambers, BF_3 counters, and boron-coated proportional counters is described. The pulse amplifier and pulse processing circuits are described. The characteristics of the installation are illustrated by graphs of the pulse forms and discrimination and proportionality curves. NSA

N68-30685# General Electric Co., Sunnyvale, Calif. Advanced Products Operation.
IMPLICATIONS OF RECENT FAST CRITICAL EXPERIMENTS ON BASIC FAST REACTOR DESIGN DATA AND CALCULATIONAL METHODS
P. Greebler, G. L. Gyorey, B. A. Hutchings, and B. M. Segal Oct. 1967 37 p refs
(Contract AT(04-3)-189)
(GEAP-5271) CFSTI: HC $3.00/MF $0.65

Recent experimental information from dilute, Pu-fueled critical assemblies is used to test and to provide guidance for improving fast reactor design data and calculational methods. The experimental data are taken from ZPR-III Assembly 47 (the SEFOR core mockup) and ZPR-III Assembly 48. The important nuclear reactor parameters are calculated with a number of variations in nuclear data and calculational techniques. An analysis of the experimental and calculated results shows that by careful adjustment of the important cross sections, well within experimental uncertainties, and by improved accuracy in the calculational methods, a much closer agreement can be achieved between calculations and experiments than that heretofore reported. A complete evaluation is made of the cross-section and resonance parameter data for Pu-239, the most important isotope in this case. The new data yield good agreement with the critical masses of ZPR-III Assemblies 47 and 48. They result in a calculated ^{239}Pu Doppler effect that is essentially zero, in agreement with the measured values. Author (NSA)

N68-30693# Argonne National Lab., Ill.
BLOWBACK OF SINTERED-METAL FILTERS: A REVIEW OF TESTS AND OPERATING EXPERIENCE
Erwin L. Carls and Norman M. Levitz Jan. 1968 32 p refs
(Contract W-31-109-ENG-38)
(ANL-7392) CFSTI: HC $3.00/MF $0.65

A review was made of the experience with automatic blow-back systems, which were used in fluidization applications to remove accumulated powders from sintered-metal filters. The blowback systems usually employ 80- to 100-psig blowback motive gas directed periodically into the filter through a 1/32 to 1/16-in. nozzle in an opposite direction to the normal process-gas flow for pulse durations of 1 sec or less. Through the use of venturis, part of the blowback motive gas is provided by the exiting filtered gas. Two parameters were calculated to reduce blowback design variables to a more fundamental form. For the operating units examined, it was found that the ratio of the blowback gas rate to the normal forward-flow filtering gas rate has ranged from 1.3 to 10.0, compared with other sources, which indicate that the optimum ratio is 0.5 to 2.0. The second parameter compared was the ratio of the volume of a blowback pulse to the volume of the internal filter; this ratio had a range of 0.5 to 8.0 for the various units. Author

N68-30698# European Atomic Energy Community, Brussels (Belgium).
THE HEAT-AFFECTED ZONE OF THE PLATE AND ITS IMPORTANCE AS REGARDS VESSEL EMBRITTLEMENT DURING FABRICATION AND IN SERVICE [LA ZONE DE LA TOLE INFLUENCEE THERMIQUEMENT PAR LE SOUDAGE. SON IMPORTANCE DU POINT DE VUE FRAGILISATION DE LA CUYE EN FABRICATION ET EN SERVICE]
J. Sebille Jan. 1967 36 p refs In FRENCH Presented at the Conf. of Experts on Recurring Inspection of Nucl. Reactor Pressure Steel Vessels, Pilsen, Czechoslovakia, 3–7 Oct. 1966 Sponsored by US–EURATOM
(ERAEC-1751; EUR-3310.f; CONF-661047-2) CFSTI: HC $3.00/MF $0.65

Effects of transition temperature on the state of steels are tabulated according to heat treated and non-heat treated. Mechanical properties and structural zones of the steels are determined. Effects of neutron fluxes of 4.5×10^{19} n/cm^2/sec and 3.5×10^{19} n/cm^2/sec are determined. All data are tabulated. NSA

N68-30701# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
DETERMINATION OF RELATIVE BURNUP BY GAMMA SCANNING EBWR FUEL RODS
D. E. Christensen and E. S. Murphy Apr. 1968 37 p refs
(Contract AT(45-1)-1830)
(BNWL-653) CFSTI: HC $3.00/MF $0.65

A set of 17 fuel rods from the Experimental Boiling Water Reactor were gamma scanned using both a NaI detector and a Ge detector. The intensity of the unresolved fuel rod gamma ray spectrum above 675 keV was measured at several points along each rod in order to determine the relative fuel burnup and core power distribution. NSA

N68-30703# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
NEUTRON DOSIMETRY FOR FAST-REACTOR IRRADIATION AND SURVEILLANCE TESTING
H. H. Yoshikawa and W. N. McElroy 8 Apr. 1968 16 p refs Presented at the ASTM Symp. on Radiation Effects to Reactor Metals, San Francisco, 23–28 Jun. 1968 Submitted for publication
(Contract AT(45-1)-1830)
(BNWL-SA-1488; CONF-680604-2) CFSTI: HC $3.00/MF $0.65

The procedure followed to assess the effectiveness of neutron irradiations in various facilities or in different positions of one reactor is described. The first step is determining the number of neutrons involved during the test. Next, the neutron spectrum is found, and the effectiveness of a neutron of energy E in causing the property change of interest is defined. This information is then combined to assess the irradiation effectiveness. Some examples of the application of the techniques are presented. NSA

N68-30712# Atlantic Richfield Hanford Co., Richland, Wash.
IGNITION AND BURNING CHARACTERISTICS OF ZPPR FUEL ALLOY
R. E. Felt 1 May 1968 11 p refs
(Contract AT(45-1)-2130)
(ARH-471) CFSTI: HC $3.00/MF $0.65

The results of ignition and burning tests on 3 clad Zero Power Plutonium Reactor fuel plates and one unclad fuel plate are presented. The fuel alloy composition was 69% U, 3% Mo, and 28% Pu, and the cladding was stainless steel. The alloy burning characteristics resembled Pu, with a peak burn temperature of 825°C. It was more difficult to ignite than Pu and burned at a lower rate. Particle release from the alloy fire was less, and it was difficult to maintain the burning alloy in contact with a heat-removal surface such as the cladding without the addition of external heat. The fire hazard associated with a ZPRR fuel plate clad in stainless steel is considered to be very limited. NSA

N68-30717# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
MASS BALANCE ESTIMATE OF THE ENERGY RELEASED PER FISSION IN A REACTOR [ESTIMATION DE L'EQUILIBRE DE MASSE DE L'ENERGIE DEGAGEE A CHAQUE FISSION DANS UN REACTEUR]
W. H. Walker Apr. 1968 12 p refs
(AECL-3109)

The total energy released per fission in a reactor is equal to the difference in mass between the reacting particles (neutron and fissile nucleus) and end products (stable or long-lived fission products, neutron capture products, etc.). The major components in this mass balance are known with a very small uncertainty and are tabulated in UCRL-16964. To obtain the energy per fission appearing as heat in a reactor, estimates are required for the energy carried away by neutrinos, the β-decay energy of long-lived fission products and the binding energy of (T-1) neutrons captured in fuel, fission products, control rods or equivalent, moderator, structural materials and shielding. Loss of energy by γ-rays and neutrons leaking through the shielding is assumed to be negligible. The calculations have been done for thermal neutron fission of U^{233}, U^{235}, Pu^{239}, and Pu^{241} and fast fission of Th^{232} and U^{238}. The calculated "MeV per fission" appearing in a CANDU-type reactor are: Th^{232}, 196.2±1.1; U^{233}, 199.0±1.1; U^{235}, 201.7±0.6; U^{238}, 208.5±1.1; Pu^{239}, 210.7±1.2; Pu^{241}, 213.8±1.0. Author

N68-30722# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
FFTF FUEL DEVELOPMENT PROGRAM
C. A. Burgess, J. E. Hanson, and B. R. Hamward 27 Mar. 1968 22 p Presented at the Am. Nucl. Soc. Natl. Topical Meeting, Cincinnati
(Contract AT(45-1)-1830)
(BNWL-SA-1750; CONF-680419-2) CFSTI: HC $3.00/MF $0.65

Fuel fabrication processes for the NPTF and FTR are described. Irradiation testing of the FTR driver fuel is also described. NSA

N68-30723# Centre d'Etude de l'Energie Nucleaire, Mol (Belgium).
REPROCESSING OF IRRADIATED FUELS Annual Report, Jul. 1966–Jun. 1967
Jun. 1967 33 p refs
(Contracts EURATOM-006-65-7; RCIE (RD); EURATOM-016-65-1 RAP B)
(EURAEC-2011; EUR-3797) CFSTI: HC $3.00/MF $0.65

Basic research has been performed in the following areas: selective volatilization of uranium in the presence of plutonium; the influence of the density and the plutonium content of the oxides on the volatilization rate of uranium; formation and composition of gaseous by-products resulting from the reaction of chlorine trifluoride and chlorine monofluoride with the U–O–F compounds; and the thermodynamics of plutonium fluoration reactions. The study of chemical decladding was continued. Autoregulation of the reaction occurred when AISI-347-canned elements were treated with a mixture of oxygen and hydrogen fluoride; during these experiments caking could generally be avoided by prefluoration of the alumina. Pulverization experiments were performed on 4-kg quantities of UO_2 pellets. It was concluded that stainless steel decladding, using $HF+O_2$ mixtures, is feasible and that pulverization of the UO_2 fuel is satisfactory. A systematic study was performed on the volatilization of uranium, using chlorine trifluoride and chlorine monofluoride and different uranium compounds. The next step in the development was the study and construction of a large unit for testing the procedures of chemical decladding, fuel pulverization, and volatilization of UF_6 using nonirradiated fuel bundles. A semi-pilot facility (SPC) was constructed and the first tests of the installed equipment were started. In the plutonium facility (SPu) some active experiments were performed, mainly in view of testing the degree of selectivity of ClF_3 for uranium and of establishing a plutonium balance. The volatilization study of some selected fission products and of neptunium was completed at tracer level. Author (NSA)

N68-30725# Gulf General Atomic, San Diego, Calif.
FAST REACTOR SPECTRUM MEASUREMENTS Quarterly Progress Report, Period Ending 31 Oct. 1967
C. A. Preskitt 21 Nov. 1967 16 p refs
(Contract AT(04-3)-177)
(GA-8377; QPR-2) CFSTI: HC $3.00/MF $0.65

Construction of the Subcritical Time-of-Flight Spectrum Facility (STSF) is described; problems encountered are discussed. An inventory of core materials present for loading the STSF is tabulated. Core and reflector composition for STSF-1 is given; reactivities of various loadings are tabulated. Neutron spectra are shown for various locations with respect to core content. Reactivity transients resulting from unintentional criticality while closing the beds are shown as a function of time. NSA

N68-30740# Aktiebolaget Atomenergi, Studsvik (Sweden).
ON THE USE OF NIOBIUM AS A NEUTRON DOSE MONITOR
S. Hellstrom Nov. 1967 25 p refs Presented at the Conf. of the Swed. Natl. Comm. for Phys., Uppsala
(FFN-74; CONF-650676-3)

Irradiation of samples of ^{93}Nb-foils together with neutron flux indicators has been done in reactor positions with different epithermal to thermal neutron flux ratios. Two samples were covered with a 1 mm thick Cd-layer. The activities from the isotopes formed: ^{94}Nb, ^{95}Nb, and ^{92}Nb were measured with a Ge(Li)-detector after purification of the samples from ^{182}Ta. The half-lives of the isotopes were re-determined: $T_{1/2}(^{94}Nb) = (2.35 \pm 0.16) \cdot 10^4$ years; $T_{1/2}(^{95}Nb) = 34.7 \pm 0.4$ days and $T_{1/2}(^{92}Nb) = 10.00 \pm 0.06$ days. The activation function of ^{94}Nb was calculated from the measured data as well as its cross sections for thermal and epithermal neutrons. Author (NSA)

N68-30750*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NEUTRONIC CALCULATIONS OF FUEL AND POISON DRUM CONTROL OF REFRACTORY-METAL, FAST-SPECTRUM, SPACE POWER REACTORS
Robert M. Westfall and Wendell Mayo Washington Aug. 1967 24 p refs
(NASA-TN-D-4709) CFSTI: HC$3.00/MF$0.65 CSCL 18L

An analytical procedure was developed to evaluate drum control worths with one-dimensional, radial, discrete ordinate transport calculations. Two types of drum control were evaluated, one with fuel drums containing a heavy-metal reflector material, the other with poison drums containing beryllium oxide and boron carbide. The one-dimensional procedure gave small-core drum control worths which agree with two-dimensional calculations to within 7 percent. The control response curves from two-dimensional calculations agree with $\sin^2(\theta/2)$ curve to within 15 percent. Poison control drum worths are sufficient for 40-centimeter-diameter cores. Fuel control drums are applicable to cores as large as 80 centimeters in diameter. Author

N68-30761# Japan Atomic Energy Research Inst., Tokyo. Div. of JPDR Operation.
THREE DIMENSIONAL NUCLEAR THERMAL-HYDRAULIC CHARACTERISTIC ANALYSIS OF JPDR CORE
Takanori Schimooke Jan. 1968 39 p refs In JAPANESE; ENGLISH summary
(JAERI-1159) CFSTI: HC$3.00/MF$0.65

Nuclear thermal-hydraulic characteristics of JPDR core have been calculated by the three dimensional nuclear thermal-hydraulic code "FLARE". The calculation results with a set of nuclear constants adopted by us are consistent with the measurement results in the JPDR core. The FLARE model proves it accuracies as follows: (1) ±0.4% in reactivity, (2) about ±2.8 MWt in thermal power (at the rated power-45 MWt), (3) within 3% of standard deviation in the channel power ratio, (4) gross peaking factors predicted are acceptable for core safety analyses with sufficient confidence, if 5% in maximum is added to the values. Many calculation results under the various reactor operation conditions are shown and it becomes clear that the design values of JPDR core, adopted by G. E. (General Electric Co.), have sufficient margin. Concrete and useful informations on flux distributions in the core are also reported as a function of the reactor power and rod patterns. In the appendix, the experimental investigation on the validity of the FLARE model from the general viewpoint is reported. Readers are referred also to the appendix for the input data used in this report. Author

N68-30764# Japan Atomic Energy Research Inst., Tokyo. Div. of Physics and Chemistry.
PROPERTIES AND STRUCTURES OF URANIUM OXIDES WITH EMPHASIS ON NONSTOICHIOMETRY
Tamotsu Ishii (Tokyo Univ., Japan) and Keiji Naito Mar. 1968 32 p refs In JAPANESE; ENGLISH summary
(JAERI-4045) CFSTI: HC$3.00/MF$0.65

There are many kinds of uranium oxide phases, $UO_2U_4O_9$, U_3O_7, U_5O_{13} (or U_2O_5 or U_8O_{21}), U_3O_8 and UO_3, with wide ranges of nonstoichiometry shown as $UO_{2\pm x}$, U_4O_{9-y}, $U_3O_{7\pm u}$, $U_5O_{13\pm v}$ and U_3O_{8-z}. Many experimental data concerning phase equilibria, thermochemical proeprties, crystal structures, phase transitions and electrical properties which were reported lately, were summarized and assessed chiefly from the view point of nonstoichiometry. Particular emphasis was placed on the phase boundaries and equilibrium pressures of oxygen in the phase diagram, variation of thermodynamic functions in a range approaching to $UO_{2.00}$, crystal structures and electrical conduction mechanism. Electrical properties of uranium oxides which depend on temperature and O/U composition were investigated and the conduction mechanism was discussed from the experimental results. Nature and mechanism of the phase transitions in U_4O_9 and U_3O_8 were discussed through the available data. Author

N68-30774# Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.
XENON-INDUCED SPATIAL INSTABILITIES IN LARGE PRESSURIZED WATER REACTORS
Claude G. Poncelet and Alan M. Christie Mar. 1968 203 p refs
(Contract AT(30-1)-3680)
(WCAP-3680-20; EURAEC-1974) CFSTI: HC$3.00/MF$0.65

The characteristics of free-running xenon-induced spatial oscillations in large pressurized water reactors (PWR's) are investigated both from a phenomenological point of view and from the standpoint of the theoretical and calculational methods employed in their analysis. The digital simulation of spatial xenon instabilities with multidimensional, multi-group diffusion theory programs is investigated in detail. An extensive study of the effect of a finite, non-zero time-step length on calculated stability characteristics is presented, including a set of correlations which permits the extrapolation of digital calculations to effectively zero time-step length. The sensitivity of the digital results to the spatial mesh length, the energy mesh, and the treatment of temperature feedback effects is investigated. The effect of a non-zero flux convergence criterion on spatial xenon oscillations is investigated. A comparison is made of modal theory results and digital simulation calculations. The space-dependent transfer function formalism is employed in a number of analyses, including the effect of delayed neutrons and the effect of finite temperature feedback time-lags. The space-time characteristics of xenon-induced instabilities in the two-dimensional plane perpendicular to the direction of coolant flow are studied for a large variety of core sizes, power distributions and temperature feedback effects. The effect of perturbation size and location is evaluated. Extensive parametric and sensitivity analyses are performed, based on a modal expansion method. Parameters investigated are core size, power distribution, power level, power coefficient, fuel enrichment, Xe-135 absorption cross section, I-135 fission yield and direct Xe-135 fission yield Parametric calculations with one- and two-dimensional diffusion theory programs are performed to corroborate the modal theory results. Author (NSA)

N68-30778# Polish Academy of Sciences, Warsaw.
CALCULATIONS OF THE WWR-SM LATTICES [OBLICZENIA SIATEK WWR-SM]
Krystyna Kowalska 1968 87 p refs
(Rept.-878/XXI/PR) CFSTI: HC$3.00/MF$0.65

Methods used for the micro- and macroscopic calculations of the experimental cores on the critical assembly of the Maryla-2 reactor are described. Computed parameters and neutron flux distributions are compared with the experimental results. The applicability of the theoretical models and the developed system of reactor codes are discussed. Author

N68-30785# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
CERAMIC FUELS FOR FAST REACTORS
Stanley Goldsmith, R. J. Jackson, and E. T. Weber 28 Mar. 1968 25 p Presented at Am. Nucl. Soc. Natl. Topical Meeting, Cincinnati, 2–4 Apr. 1968
(Contract AT(45-1)-1830)
(BNWL-SA-1550; CONF-680418-3) CFSTI: HC $3.00/MF $0.65

The performance potential of the U–Pu ceramic compounds—oxides, carbides, and nitrides—under current development as liquid metal cooled fast breeder reactor fuels is discussed. The fast reactor fuel operating conditions and material characteristics are examined, and thermal properties, swelling behavior, and compatibility of the fuels with cladding and with Na are compared. Factors which influence fuel pin performance are examined, and the need for information on prototype fuel pin operation under conditions representative of fast reactors is discussed. NSA

N68-30805# Bettis Atomic Power Lab., Pittsburgh, Pa.
A NONLINEAR CONTINUUM CREEP MODEL FOR THE SWELLING OF CERAMIC NUCLEAR FUELS (LWBR DEVELOPMENT PROGRAM)
N. C. Small Apr. 1968 31 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-TM-755) CFSTI: HC $3.00/MF $0.65

A nonlinear continuum model is described for the creep swelling of ceramic nuclear fuel materials. The theory includes the effects of fabricated porosity, fission induced porosity and surface tension. The same macroscopic dilatational element is utilized in the form of a hollow (fabricated pore) spherical element whose annulus is composed of analogous microscopic hollow (fission pore) spherical-sub-elements. A three dimensional theory is developed, and this is subsequently specialized to the case of one dimensional strain. Numerical results are given and discussed for this latter case. Author (NSA)

N68-30817# Polish Academy of Sciences, Warsaw.
CLADDING TEMPERATURE MEASUREMENTS OF THE EK-10 TYPE REACTOR FUEL RODS IN EWA-2 CORE [POMIARY TEMPERATURY KOSZULKI PRETA PALIWOWEGO EK-10 W RDZENIU REAKTORA EWA-2]
J. Aleksandrowicz, M. Czerniewski, and L. Labno 1968 43 p refs
(Rept.-879/XI/R) CFSTI: HC $3.00/MF $0.65

A program of EK-10 type fuel rods temperature measurements was performed in the EWA reactor by steady state and transient conditions. Temperature transients were measured during flow failure type-test and by tests initiated by ramp reactivity addition. The results of the cladding temperature measurements performed in EWA-2 core are presented. The results are completed by measured data of the temperature effects on reactivity in the investigated core. Author

N68-30850# Centre d'Etude de l'Energie Nucleaire, Mol (Belgium).
USE OF PLUTONIUM AS FUEL IN NUCLEAR REACTORS Quarterly Report
H. Bairiot, A. Lhost, and A. Deramaix Jan. 1968 66 p Prepared jointly with Soc. Belge pour l'Industrie Nucl., Brussels
(Contract EURATOM-001-64-1 TRUB)
(QR-16; EURAEC-1992; EUR-3787) CFSTI: HC $3.00/MF $0.65

Research related to the use of plutonium as fuel in nuclear reactors is reported: (1) Nuclear fuel elements were fabricated and tested; (2) The weldability of Zircaloy-2 was studied; (3) Fluorine and carbon were determined in mixed oxide fuels by titration; (4) Plutonium diffusion and neutron cross section resonance were studied; (5) Neutron physics analysis of Pu and U oxide was carried out; (6) Distribution of Pu and U oxide in mixed oxide fuels were found; and (7) Development of Pu for use as reactor fuel is described. NSA

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N68-29582 Rensselaer Polytechnic Inst., Troy, N. Y.
THE POST-NEWTONIAN-COULOMBIC EQUATIONS OF MOTION FOR RIGIDLY ROTATING, CHARGED FLUID BODIES
Robert J. Martineau (Ph.D. Thesis) 1968 114 p
Available from Univ. Microfilms: HC $5.80/MF $3.00 Order No. 67-9289

The object of this paper is to give a logically simple derivation of the equations of motion for a system of disjoint, charged, fluid bodies which rotate as if they were rigid. In order to achieve this objective we make the following physical assumptions: (a) The physical model is governed by the Einstein–Maxwell system of differential equations. (b) The gravitational and electromagnetic fields do not vary rapidly in time (the fields are essentially quasi-static). (c) space-time is asymptotically flat. (d) The characteristic interbody distance is large in comparison to the characteristic body dimension. We begin the derivation by applying the Einstein–Fock approximation procedure to the Einstein–Maxwell system of field equations. This allows us to break up the nonlinearity of the field equations at each stage of the approximation, and thus to obtain a system of linear differential equations for the field functions with source terms determined by the assumed energy-momentum-stress distribution and charge distribution. Dissert. Abstr.

N68-29616 Colorado Univ., Denver.
THE SCATTERING OF PARTICLES FROM A ROUGH SURFACE
Timothy John Healy (Ph.D. Thesis) 1966 117 p
Available from Univ. Microfilms: HC $5.80/MF $3.00 Order No. 67-9966

It is well known that under certain circumstances particles which strike a surface undergo preferential scattering. With this form of scattering, particles leave the surface with a relatively narrow angular probability distribution. The peak of the distribution lobe is usually directed a few degrees away from the direction of specular reflection toward the normal to the surface. Little theoretical work has been done to explain the shape of the distribution lobe or its angular displacement from the line of specular reflection. The purpose of this thesis is to suggest a model which does explain these phenomena. The model is based on two assumptions. The first is that the surface is rough, with random normally distributed height. The second assumption is that a particle which strikes a slope of the rough surface is reflected specularly with respect to the local normal to the slope which is struck. Thus, since the normals to the slopes are randomly distributed, the particles will be scattered randomly. The actual distribution of scattered particles is obtained through a transformation of the random process which describes the slopes of the surface. The resulting probability distribution is the central result of the study. The direction of the peak of the distribution lobe is found by maximizing the probability distribution with respect to the angle of incidence. Dissert. Abstr.

N68-29628 Ohio State Univ., Columbus.
ASYMPTOTIC SERIES DESCRIBING THE DIFFRACTION OF A PLANE WAVE BY A TWO-DIMENSIONAL WEDGE OF ARBITRARY ANGLE
David Lee Hutchins (Ph.D. Thesis) 1967 152 p
Available from Univ. Microfilms: HC $7.20/MF $3.00 Order No. 67-10903

The Pauli and the Oberhettinger asymptotic expansions for the diffracted field produced by the scattering of a plane wave by a wedge are compared analytically and numerically, and their range of application is extended. The Pauli–Clemmow method of steepest descents is used to evaluate Sommerfield's complex integral expression for the total field produced by the scattering of a plane electromagnetic wave by a perfectly conducting wedge. This generalized form of Pauli's expansion can, for example, by applied to the computation of the fields diffracted by wedges which have exterior angles less than 180 degrees. It is shown that simply by rearranging the terms in this generalized Pauli expansion a generalized form of Oberhettinger's asymptotic expansion can be produced. This generalized expansion is applicable to problems involving wedges having exterior angles less than 180 degrees, and it is identical with Oberhettinger's original series when the wedge angle is greater than this value. Several examples of scattering of a plane wave by a wedge are studied numerically. Dissert. Abstr.

N68-29666 Kansas Univ., Lawrence.
AN ANALYSIS OF ELECTROMAGNETIC DISPLACEMENT CURRENT CIRCUITS
Theodore Earl Batchman (Ph.D. Thesis) 1968 148 p
Available from Univ. Microfilms: HC $7.00/MF $3.00 Order No. 67-10798

Maxwell defined the electric displacement current as the time rate of change of electric flux. The primary use made of electric displacement currents in circuits is in the capacitor. In the present study, both electric and magnetic displacement current circuits are considered from the point of view of ordinary conduction current analysis methods. Considering these currents leads to the development of a dielectric transformer. A review of Maxwell's definition and the controversies arising over this definition are presented in Chapter I. Chapter II discusses the materials which make good conductors of electric and magnetic displacement currents. Dielectric material properties are considered in some detail here. The third chapter develops the Biot-Savart law analogy for displacement current loops so that conventional conduction current inductance formulas can be applied to displacement current inductances. The next chapter analyzes an ordinary magnetic transformer using magnetic displacement currents. Chapter V presents the development of the dielectric transformer. Dissert. Abstr.

N68-29671*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
RECENT ADVANCES IN COHERENT OPTICS. FILTERING OF SPATIAL FREQUENCIES; HOLOGRAPHY
Serge Lowenthal and Yves Belvaux Redstone Arsenal, Ala. Redstone Sci. Inform. Center 28 Mar. 1968 101 p refs Transl. into ENGLISH from Rev. D'Optique (Paris), v. 46, no. 1, 1967 p 1–64 Prepared jointly with Army Missile Command
(NASA-TM-X-61024; RSIC-769) CFSTI: HC $3.00/MF $0.65
CSCL 20F

New applications of coherent light are presented: (a) Holography: recording of three-dimensional objects; diffuse illumination interferometry; reproduction of holograms; Fourier transform holography and geometrical properties of holograms; and (b) Spatial filtering: optical data processing, especially pattern recognition; automatic reading of characters, identification of fingerprints and other signals. Author

N68-29679 Iowa State Univ. of Science and Technology, Ames.
EFFECT OF RESIDENCE TIME AND SUSPENSION DENSITY ON CRYSTAL SIZE DISTRIBUTIONS IN CONTINUOUS CRYSTALLIZATION
Delmar Clarence Timm (Ph.D. Thesis) 1967 131 p
Available from Univ. Microfilms: HC $6.40/MF $3.00 Order No. 67-13005

A recently developed model relating crystal size distribution, nucleation and growth kinetics and operating parameters was compared with experimental crystal size distribution data obtained from a continuous, mixed suspension, mixed product removal, salting out crystallization system. The effects of residence time (or production rate) and suspension density upon the resulting size distributions were extensively investigated for several crystal systems. The results demonstrated that the nucleation rate can be related to crystal growth rate and suspension density as a simple power function over a wide range of levels of supersaturation. The model was used to simulate crystal size distribution dynamics for step changes in solute feed concentration and in residence time from initial steady state conditions. Qualitative agreement between theory and experimental observations was obtained by using the previously stated nucleation rate relationship. Dissert. Abstr.

N68-29708#
METHOD OF LABORATORY INVESTIGATION OF LIGHT SCATTERING IN A CORONOGRAPH OBJECTIVE
A. A. Sazanov [1968] 12 p refs Transl. into ENGLISH from Astron. Zh. (Moscow), v. 45, no. 2, 1968 p 438–446
CFSTI: HC $3.00/MF $0.65

Requirements for laboratory experiments investigating light scattering in objectives needed in connection with the construction of large-scale extra-eclipse coronographs are discussed. Results are presented of an investigation of the dependence of light scattering in the objective on the angular dimension of the source and the distance to it. Author

N68-29724# Gottingen Univ. (West Germany). Third Inst. of Physical Sciences.
INTERACTION BETWEEN AIR FLOW AND AIRBORNE SOUND IN A DUCT. VOLUME 2: ACOUSTIC EXCITATION OF BOUNDARY LAYER AND RADIATION IMPEDANCE OF ORIFICES Final Report, Feb. 1964–Jan. 1965
F. P. Mechel, P. A. Mertens, and W. M. Schilz Wright-Patterson AFB, Ohio AMRL Nov. 1967 55 p refs
(Contract AF 61(052)-666)
(AMRL-TR-67-120, V. 2; AD-669358)

The report presents the results of three experimental studies on the interaction between air flow and airborne sound in a duct. The first experiment concerns the excitation and suppression of boundary-layer distortions (created by flexural wave-like wall oscillations). Mathematical approximations show and experimental results confirm that the stability of the boundary layer is shifted to higher Reynolds numbers by the flexural wave. The second experiment relates the boundary-layer (produced by static suction) stabilization to the sound field influencing it. Results show that the particle velocity of sound penetrating a porous section of the wall leads to an increase of boundary-layer distortions and that this effect could be suppressed when the flow velocity of the static suction exceeded a threshold value. The final experiment shows the influence of a superimposed air flow on the acoustic impedance of orifices terminating a tube and of constriction, enlargements, and nozzles within a tube. Results show that if the frequency is scaled according to the Mach number, then the ratio between the reflection coefficient gamma pm at Mach number M and the reflection coefficient at zero flow velocity gamma po is independent from the frequency. Author (TAB)

N68-29850#
INFLUENCE OF STRESSES ON THE VELOCITY OF ULTRASONIC WAVE PROPAGATION IN METALS
O. I. Gushcha and V. K. Lebedev [1968] 4 p refs Transl. into ENGLISH from Prikl. Mekh. (USSR), v. 4, no. 2, 1968 p 89–92
CFSTI: HC $3.00/MF $0.65

Influence of the uniaxial stresses on the velocity of transverse ultrasonic wave propagation in steel, aluminum, and titanium alloys was studied experimentally. As tension increased, the velocity of the

waves polarized along the stresses decreased, while the velocity of the waves polarized across the stresses increased. The velocity changes, which were about twice as much in the former as in the latter case, were then used to analyze stresses in metals. An instrument for measuring ultrasonic wave propagation in metals is based on measuring the pulse repetition rate by a closed self-synchronizing system; and graphs are included to show change in ultrasonic wave velocity. The magnitude of the velocity change under the effects of stress was substantially dependent on the sample material used, with the least change shown for steel. Velocity difference changes linearly as the tension of all the samples increased to yield point. M.W.R.

N68-29861 Wisconsin Univ., Madison.
THE COMPLEX DIELECTRIC CONSTANT OF LIQUIDS IN THE CENTIMETER WAVELENGTH REGION
John Daniel Cutnell (Ph.D. Thesis) 1967 278 p
Available from Univ. Microfilms: HC $12.60/MF $3.60 Order No. 67-8993

Maxwell's macroscopic field equations have been presented and applied to the problem of the propagation of an electro-magnetic field in a rectangular waveguide. The problem of multiple reflections in waveguide has been discussed. The expression for the power reflection coefficient of a section of waveguide ultimately backed by a totally reflecting plunger and containing two different dielectric media separated by a boundary surface has been obtained. Transmission line theory and its relevance to in-waveguide reflections also has been discussed. Apparatus has been developed for measuring the complex dielectric constant of liquids as a function of frequency. Extensive test measurements with the apparatus have been made for chlorobenzene at 25.0°C. The results obtained are at wavelengths of 2.50, 2.63, 2.71, 2.80, 2.91, 3.11, and 2.48 cm. Dissert. Abstr.

N68-29989*# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SOUND IN NATURE AND THE ACOUSTIC CLIMATE [ZVUK V PRIRODE I AKUSTICHESKIY KLIMAT]
V. I. Arabadzhi 11 Aug. 1967 26 p Transl. into ENGLISH from Priroda (Moscow), no. 11, 1965 p 41–49
(FTD-MT-66-174; AD-669301)

The author discusses various problems in acoustic climatology, i.e., the acoustic regime of a locality as determined by the excitation and propagation of sound waves. The propagation of sound in the atmosphere, ionosphere, and on earth is described. The concepts of sound shadow, wave channels, wave-guides, range of audibility, sonic vibrations, bioacoustics, etc., are discussed. TAB

N68-30020*# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CURRENT PAUSE DURING ELECTRIC EXPLOSION OF LITTLE WIRES IN THE AIR [TOKOVAYA PAUZA PRI ELEKTRICHESKOM VZRYVE PROVOLOCHEK V VOZDUKHE]
K. I. Dolmatov, A. N. Tazitdinov, and Yu. I. Timokhina 31 Oct. 1967 9 p refs Transl. into ENGLISH from Izv. Akad. Nauk Uz. SSR, Ser. Fiz. Mat. Nauk (Tashkent), no. 5, 1966 p 88–89
(FTD-HT-23-827-67; AD-669299)

A study of the nature of the interruption of current during the electrical explosion of fine wires in air is described. The interruption of current is the time interval between the end of the first and the beginning of the second current pulse flowing through the fine wire. An RLC circuit (R = 0.02 omega; L = 0.4 mu h; C = 300 mu h (consisting of two IM-5-15 capacitors connected in parallel) was used to send current through the fine wire. The capacitor was charged to 3.1 kv at the beginning of each test. An oscillograph was connected to the movable arm of a potentiometer connected across the wire sample. Samples of W, Mo, Ta, and Fe wires with lengths ranging from 5 to 150 mm and diameters from 0.05 to 0.30 mm were used in the tests. Test results for 50-mm long W, Mo, Ta, and Fe wires with diameters of 0.30, 0.14, and 0.24 mm are shown in Fig. 1. The duration of the interruption of current for wires made from above metals is more stable than that for copper wires. The interruption duration is a function of the wire length and diameter; it increases sharply with wire length. At high initial voltages across the capacitor current pauses are very short and it is difficult to establish their dependence on the wire diameter. Current interruption duration decreases with increasing initial voltage across the capacitor. Orig. art. has: 3 figures and 1 table. Author (TAB)

N68-30158 Auburn Univ., Ala.
ACCEPTABLE MOTIONS OF DYNAMICAL SYSTEM
Paul Milam Julich (Ph.D. Thesis) 1967 115 p
Available from Univ. Microfilms: HC $5.60/MF $3.00 Order No. 67-12518

The concept of acceptable motions of dynamical systems is presented. An acceptable motion and an asymptotically stable acceptable motion are defined and some basic properties of such motions are indicated. Linear and nonlinear control systems are considered as examples and a method is developed for estimating the region of acceptable motions. This method is based upon the direct method of Lyapunov. One step in estimating the region of acceptable motions of a physical system is to estimate the region of asymptotic stability of the mathematical model. The estimation problem is formulated as a minimization problem using the penalty function approach. The minimization problem is solved on the digital computer via the Davidon method. The concept of practical stability is examined because it is closely related to the concept of acceptable motions. A computer technique is developed to estimate the region of practical stability. Dissert. Abstr.

N68-30252 Pennsylvania Univ., Philadelphia.
ACOUSTICAL ACTIVITY AND RELATED PHENOMENA IN CRYSTALS
David Lawrence Portigal (Ph.D. Thesis) 1967 198 p
Available from Univ. Microfilms: HC $9.00/MF $3.00 Order No. 67-12793

Rotatory polarization of transverse acoustic waves is considered. It is demonstrated phenomenologically that, due to spatial dispersion, such acoustical activity should be observable in optically active crystal classes, its magnitude being obtainable from phonon dispersion curves. An estimate of the acoustical activity of Tellurium is so obtained. An attempt to measure the acoustical activity of Tellurium is described. Alignment requirements are shown to be too critical to permit the detection of activity in such trigonal crystals. The effect of conical refraction on the observation of acoustical activity is considered. A similar formalism is applied to an improved study of optical internal conical refraction. Dissert. Abstr.

N68-30270*# Eidgenossische Technische Hochschule, Zurich (Switzerland).
INVESTIGATION OF THE CORRECTING CONDITION OF PHOTO-OBJECTIVES BASED ON ONE OF M. HERZBERGER'S PROPOSED METHODS FOR THE ANALYSIS OF DIAPOINT ABERRATIONS [UNTERSUCHUNG DES KORREKTIONSZUSTANDES VON PHOTO-OBJEKTIVEN NACH EINER VON M. HERZBERGER VORGESCHLAGENEN METHODE DER ANALYSE DER DIAPUNKSABERRATIONEN]
Klaus Hildebrand (Ph.D. Thesis) 1967 118 p refs In GERMAN
(Prom.-4061) CFSTI: HC $3.00/MF $0.65

Investigated are the relationships between diapoint configurations and image forming parameters of twelve photographic lenses at various apertures and light distribution angles. A

mathematical model is used to obtain the diapoint coordinates in the light distribution of an optical ray system of known dimensions and the diapoint aberrations are calculated by least square methods from a coordinate system representing the functions of the lens aperture. Correlations between image defects and aperture coordinates as well as with aperture diameters give the diapoint distribution in the principle ray direction; diapoint length aberrations constitute the differences between the calculated mean values and the presupposed values. Chromatic aberrations and diffraction effects are not considered. Transl. by G.G.

N68-30321# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ELECTRON PARAMAGNETIC RESONANCE IN CRYSTALS [ELEKTRONNYI PARAMAGNITNYI REZONANS V KRISTALLAKH]

M. M. Zaripov and L. Ya. Shekun Aug. 1967 57 p refs Transl. into ENGLISH from the book "Paramagnitnyy Rezonans" Kazan, Izd-Vo Kazanskoga Univ., 1964 p 5-41
(FTD-MT-24-147-67; AD-670073)

Ordinary spin Hamiltonians are used for describing electron paramagnetic resonance spectra in crystals. Expressions are given for the operators which describe the fine structure of the spectra for various types of electric field symmetry: cubic, hexagonal, triagonal, tetragonal, ghombic and purely axial. The procedures used for absorption line identification to find the constants of the spin Hamiltonian are discussed. Expressions are given for calculating the hyperfine structure due to interaction between the electron magnetic moment and the magnetic moment of the nucleus of the paramagnetic atom. Experimental research done at the Kazan University on electron paramagnetic resonance spectra in crystals is briefly reviewed. The data on ions with identical effective spins are grouped together. Ions with spins of 1/2, 3/2, 5/2 and 7/2 are considered. Author (TAB)

N68-30372# IIT Research Inst., Chicago, Ill.

FIBER OPTICS WITH EXTENDED ULTRAVIOLET TRANSMISSION Second Triannual Report, 1 Nov. 1967-29 Feb. 1968

P. C. Li, M. A. Ali, O. H. Olson, and M. A. Schwartz May 1968 38 p ref
(Contract DAAB07-67-C-0542)
(ECOM-0542-2; AD-670079)

The objective of this contract is to conduct a research and development program leading to the fabrication of fiber-optic faceplates for cathode ray tubes with high transmission in the near- and middle-ultraviolet spectral regions. The first years study is primarily to evaluate existing optical glasses (phase I) and develop improved ones suitable for meeting the specific performance requirements of the contract (phase II). Screening studies on commercial optical glasses were continued and compositions were analyzed. New multicomponent glasses, having a wide range of compositions were formulated. Spectral transmission, refractive index and absorption coefficient properties were measured. High index glasses in the zinc-lanthanum borate, zinc-calcium-lanthanum borate, and barium-calcium-lanthanum borate systems exhibited high transmission in the spectral region of interest. Exploratory work to further improve the transmission of glasses in these systems is being continued. One of the low index glasses prepared from pure raw materials exhibited excellent uv transmission. A number of other glass compositions using less pure materials were suitable for preliminary evaluation of stability and refractive index. Author (TAB)

N68-30393*# Institut Franco-Allemand de Recherches, St. Louis (France).

TWO EXAMPLES FOR PHOTOELASTIC DETERMINATION OF THE PRIMARY DIRECTIONS OF CONSTRAINTS IN A DYNAMIC SYSTEM [DEUX EXEMPLES DE DETERMINATION PHOTOELASTICIMETRIQUE DES DIRECTIONS PRINCIPALES DES CONSTRAINTES EN REGIME DYNAMIQUE]

F. Hagry 5 Oct. 1967 20 p refs In FRENCH
(T-38/67) CFSTI: HC $3.00/MF $0.65

Two examples are discussed for determining the direction of different stages of shock wave envelopment in a cylindrical cavity. Consideration is given to obtaining isochromatic data, determining the isoclines, effect on incident and reflected waves, and isostatic plotting. Photographs are reproduced to illustrate the text. From the limited results obtained, it was possible to determine the direction of the principal constraints. Transl. by M.G.J.

N68-30394# Institut Franco-Allemand de Recherches, St. Louis (France).

POLARISCOPIC INVESTIGATION OF THE DIFFRACTION OF A WAVE INDUCED IN A SOLID BY A WEAK AERIAL SHOCK WAVE THROUGH A CYLINDRICAL HOLLOW [VISUALISATION AU POLARISCOPE DE LA DIFFRACTION PAR UNE CAVITE CYLINDRIQUE DE L'ONDE INDUITE DANS UN SOLIDE PAR UNE ONDE DE CHOC AERIENNE FAIBLE]

F. Hagry 26 Jan. 1967 21 p refs In FRENCH
(T-3/7) CFSTI: HC $3.00/MF $0.65

Test results are presented on the visualization of the envelopment of a cylindrical cavity by a deformed wave induced by a straight aerial shock wave of weak intensity, and of the perturbations of the constrained field which it excited. Details are given on the experimental apparatus and on the rectangular parallelepiped model used. The photographs obtained during the experiments are reproduced and discussed in detail. Transl. by M.G.J.

N68-30441# Naval Air Development Center, Johnsville, Pa. Electronic Technology Dept.

MATCHED SPATIAL FILTERING Final Report

S. B. Greenberg and H. B. Perkins 19 Apr. 1968 42 p refs
(NADC-AE-6764; AD-669985)

Several experimental studies were made on the feasibility of the Vander Lugt technique of pattern recognition by matched spatial filtering of coherent light. Pseudo-random code signals were used. Variables included exposure time of matched filter, ratio of signal beam to reference beam, and bandwidth of matched filter. Strong correlations were obtained, but the system was found limited because of its use of photographic film. Author (TAB)

N68-30598*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

MEASUREMENT OF THE TRANSMISSIVITY OF A CARBON-PARTICLE-SEEDED NITROGEN JET

Chester D. Lanzo Washington Aug. 1968 18 p refs
(NASA-TN-D-4722) CFSTI: HC $3.00/MF $0.65 CSCL 20F

An experiment was conducted to measure the transmissivity of a flowing steam of nitrogen gas that had been seeded with nominal 0.009-micron carbon particles. The seed density and light-beam wavelength were the variables of the experiment. Seed density was varied from 10^{-5} to 10^{-4} g/cm^3. Wavelength was varied from 200 millimicrons to 3500 millimicrons. The results are presented as a ratio of transmitted to incident light intensity, and as an absorption cross section. Scattering is assumed to be unimportant. The experimental results show that the absorption cross section decreases as the seed density increases. This is attributed to particle agglomeration. The measurements also show that, for all practical purposes, the absorption cross section is independent of wavelength for wavelengths from 200 to 3500 millimicrons. Author

N68-30736# Dept. of Housing and Urban Development, Washington, D. C.
AIRBORNE, IMPACT, AND STRUCTURE BORNE NOISE-CONTROL IN MULTIFAMILY DWELLINGS
Raymond D. Berendt (Natl. Bur. Std.), George E. Winzer (Natl. Bur. Std.), and Courtney B. Burroughs (Natl. Bur. Std.) Washington GPO Sep. 1967 208 p refs Prepared in cooperation with Natl. Bur. Std., Washington, D. C.
(AD-669933) GPO: HC $12.50; CFSTI: MF $0.65

Contents: General principles of sound transmission; Classification of noise; Flanking transmission of airborne and structure-borne noise; General principles of noise control; Control of airborne noise; Control of structure-borne noise; Practical solutions to control building noise; Development of criteria; FHA recommended criteria; Discussion and presentation of data. TAB

N68-30744# Pennsylvania State Univ., University Park. Dept. of Electrical Engineering.
LECTURE NOTES ON WAVE PROPAGATION
A. H. Waynick 10 Aug. 1968 111 p
(Grant NSF GP-5611)
(SR-321)

A compilation of lecture notes prepared for a course on electromagnetic wave propagation is reported. Contents include a discussion of: vector relationships, vector analysis, the electromagnetic equations; Maxwell's equations; plane waves in various types of media; Lorentz equations; the theory of dispersion; the Appleton–Hartree equation; and the propagation of electromagnetic waves in the ionosphere. S.C.W.

N68-30757# Applicazioni E Ricerche Scientifiche, Naples (Italy).
ACOUSTIC WAVE PROPAGATION IN A DISSOCIATING AND DIFFUSING GAS. PART 1: GENERAL THEORY PART 2: PARTICULAR CASES
R. Monti and L. G. Napolitano Feb. 1968 62 p refs
(Contract N62558-4564)
(AD-670087)

A general analysis is presented of linear unsteady propagation of small disturbances through a dissociating, viscous, heat conducting and diffusing gas. Contents: Thermodynamics of the mixture; Basic equations; Non dimensionalization; Non dimensional equations; Linearization of the equations; Solution of the system; Separate waves; Uncoupled waves; Non diffusing mixture; One component gas; Low frequency limit. TAB

N68-30770# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
APPLICABILITY OF THE THEORY OF MULTIPLE LIGHT SCATTERING IN THE ATMOSPHERE TO THE EFFECT OF ANOMALOUS TRANSPARENCY [O PRIMENIMOSTI TEORII MNOGOKRATNOGO RASSEYANIYA SVETA V ATMOSFERE K EFFEKTU ANOMAL'NOY PROZRACHNOSTI]
S. F. Rodionov and B. N. Movchan 15 Sep. 1967 15 p refs Transl. into ENGLISH from Probl. Fiz. Atm. (Leningrad), no. 3, 1965 p 48–54
(FTD-HT-67-257; AD-670068)

It is shown that experimental observations confirm the estimates of atmospheric light scattering in the ultraviolet region derived by S. F. Rodionov (Izv. AN SSR, seriya geogr. i geofiz. v14 no4 1950). TAB

N68-30802# Naval Research Lab., Washington, D. C.
A REVIEW OF WORLD CONTRIBUTIONS FROM 1945 TO 1965 TO THE THEORY OF ACOUSTIC RADIATION. CHAPTER 4: MULTIPOLE ANALYSIS AND RADIATION FROM SURFACES OF LARGE RADIUS OF CURVATURE
S. Hanish 15 Feb. 1968 99 p
(NRL-MEMO-1865; AD-670000)

The report constitutes a first draft of Chapter IV of a treatise on recent advances in the theory of acoustic radiation from volume and surface distributed sources. It reviews in detail post 1945 papers on multipole analysis of radiation, Greens functions and their relation to acoustic multipoles, radiation from pistons, strips and zones on baffles of very large size, and creeping waves in the steady state and transient scattering from spheres and cylinders. Author (TAB)

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N68-29570 California Univ., Los Angeles.
PERFORMANCE OF AN ARC-HEATED SUPERSONIC MOLECULAR BEAM AND ITS APPLICATION TO MOLECULE-MOLECULE COLLISION STUDIES
Neil Marshall Kuluva (Ph.D. Thesis) 1967 131 p
Available from Univ. Microfilms: HC $6.40/MF $3.00 Order No. 67-12226

Properties and design characteristics of a arc-heated, supersonic, argon molecular beam were studied analytically and experimentally. Preliminary measurements of argon-argon scattering at relative energies of 1-ev were conducted. The molecular-beam system which was studied consists of four main chambers. The stagnation chamber (plasma head) contains an arc between two electrodes for adding energy to the argon gas as it passes through. The gas then leaves the stagnation chamber through a sonic nozzle and expands in the form of a free jet into the source chamber wherein the majority of the gas molecules are pumped away by a booster diffusion pump. The central core of the free jet then passes through a conical skimmer into the collimating chamber and the beam is thus formed. Often a beam chopper, a velocity filter or a scattering chamber is mounted in the collimating chamber to facilitate particular experiments. The beam finally passes through a small orifice into the detection chamber where the detector and various auxiliary equipment are housed. The molecular beam density, energy, and velocity distribution were studied experimentally. Dissert. Abstr.

N68-29637 Florida Univ., Gainesville.
A PRODUCT-PAIR GROUND STATE WAVE FUNCTION FOR He^4
Joon Chang Lee (Ph.D. Thesis) 1966 59 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-12936

This dissertation is to present a variational study of the ground state of liquid He^4 with the pair-wise trial wave function, which is often called Bij1–Jastrow type of wave function. Chapter II is taken up by the derivation of an Euler-Lagrange equation to determine the radial distribution function and thus the optimum wave function. This equation is solved in a series form for very small r in Chapter III. The low lying excited states of liquid He^4 can be studied from the ground state wave function. It was proposed some time ago that this excitation energy spectrum is phonon-like. Feynman suggested a relation between the structure factor for small wave number k and the velocity of sound through a series of elegant physical arguments. In Chapter IV, the equation derived in Chapter II was solved for large r to determine the structure factor for small k. It was found that the phonon-like excitation

spectrum does indeed exist in this theory. The velocity of sound found in this way is in a good agreement with the experiment. Dissert. Abstr.

N68-29642 Yeshiva Univ., New York.
EXACT ANALYSIS OF AN INTERACTING FERMI GAS. THE TWO SPIN DEVIATE PROBLEM
Michael Flicker (Ph.D. Thesis) 1966 95 p
Available from Univ. Microfilms: HC $4.80/MF $3.00 Order No. 67-9933

A gas of one-dimensional Fermi particles with spin interacting via a repulsive delta-function potential has been solved exactly. The energy of the ground state and low lying excited states has been calculated explicitly for $S^z_{total} = (N/2) - 2$. All the eigenfunctions and energies can be found. It is believed that this technique can be used to determine the energies and eigenfunctions for all values of S^z_{total} from 0 to N/2. Dissert. Abstr.

N68-29643 Fordham Univ., New York.
THE CALCULATION OF HYLLERAAS-TYPE CORRELATED WAVEFUNCTIONS FOR THE GROUND STATE OF THE BERYLLIUM ATOM
John Edward Byrne (Ph.D. Thesis) 1967 142 p
Available from Univ. Microfilms: HC $6.80/MF $3.00 Order No. 67-11482

The Theory of Correlated Wavefunctions is applied to calculate the ground-state energy of the Beryllium atom. The method involves computing Hylleraas-type functions for this particular state. As the theory is formulated it is a general theory, i.e., it can be applied to atoms with arbitrary numbers of electrons and to any degree of approximation required. As applied to Beryllium in this thesis only two-particle correlations are considered. Several different correlation factors as well as several different combinations of orbital functions are considered. The correlation energy in any system is defined as the difference between the exact non-relativistic energy of the system and the energy as calculated using the Hartree–Fock approximation. Hartree–Fock energies are usually in error by an amount which is of the order of 1%. This error arises from the fact that in this approximation, the correlation between the individual motions of the electrons is not completely taken into account. Dissert. Abstr.

N68-29651# International Centre for Theoretical Physics, Trieste (Italy).
KEPLER'S EQUATION, FOCK VARIABLES, BACRY'S GENERATORS AND DIRAC BRACKETS
G. Gyorgyi (Hung. Acad. of Sci.) Vienna Intern. Atomic Energy Agency Jun. 1967 30 p refs Submitted for publication
(IC-67-46) CFSTI: HC $3.00/MF $0.65

A formulation of the Kepler problem, manifestly invariant with respect to the SO(4) and SO(3,1) groups, is given in terms of the Fock variables and their canonical conjugates; one is led to introduce a new time parameter, proportional to the eccentric anomaly. A transformation of the dynamical variables performed in order to get back the standard time leads in a natural way to Bacry's generators. A manifestly SO(4,2) invariant formulation of the problem is given. The concept of the Dirac bracket is used to establish a connection with the usual three-dimensional description. Author (ESRO)

N68-29652# International Centre for Theoretical Physics, Trieste (Italy).
ON THE BINDING ENERGY OF A Λ PARTICLE IN NUCLEAR MATTER
M. E. Gpypeos, L. P. Kok (Groningen State Univ.), and S. Ali (Atomic Energy Centre, Dacca) Vienna Intern. Atomic Energy Agency Submitted for publication
(IC-67-49) CFSTI: HC $3.00/MF $0.65

A functional variation, under a suitable integral constraint of the first-order expression derived for the ground state energy of a Λ particle in nuclear matter is performed. The general features of the approach described are discussed by using a simplified Λ-nucleon interaction. Author (ESRO)

N68-29660 New York Univ., N. Y.
SOME QUARK MODELS OF ELEMENTARY PARTICLES
Paul Horwitz (Ph.D. Thesis) 1967 122 p
Available from Univ. Microfilms: HC $6.00/MF $3.00 Order No. 67-10975

Starting from the two-body Dirac equation with a static, local square well potential, the behavior of the total bound state energy as a function of potential strength for a system of two soinor particles. For scalar, vector, and axial vector coupling, and unequal mass particles, it was found that there do not exist tightly bound solutions of this equation which have the physically desirable property of approaching a state of two free, positive energy spinors as the potential is adiabatically turned off. For tensor coupling, tightly bound solutions do exist if the potential is sufficiently strong. No bound state solutions exist at all for pseudoscalar coupling. Using a non-covariant reduction of the Bethe–Salpeter equation for a quark and an antiquark interacting through exchange of a massive vector field, in the ladder approximation, and representing the interaction by a separable S-wave potential, the wave functions of the $^1S_0$ and $^3S_1$ states were found and identified with the physical π and ρ mesons, respectively. Dissert. Abstr.

N68-29669# Aerospace Corp., San Bernardino, Calif.
COHERENCE AND PROPERTIES OF THE RIGHT EIGENSTATES OF THE ANNIHILATION OPERATOR
Technical Report, Jun.–Nov. 1967
M. Tavis Feb. 1968 58 p refs
(Contract F04696-67-C-0158)
(TR-0158(S3816-88)-1; SAMSO-TR-68-205; AD-669380)

The report reviews some of the more recent quantum mechanical aspects of photon counting, optical coherence, and the space-time correlation of a lightbeam. The coherent states of the radiation field are defined in terms of the photon number states, and it is seen that these coherent states are the best ones to describe a classical radiation field, in that photon number and phase have an exact compromise for these states. A short discussion of the phase state is given. Many properties of the coherent state are described, and the density matrix for a mixed coherent and noise field in the photon number representation is given. Author (TAB)

N68-29686 California Univ., Los Angeles.
A QUANTUM MECHANICAL STUDY OF THE ELECTRON GAS VIA THE TEST PARTICLE METHOD
Marvin Edward Rensink (Ph.D. Thesis) 1967 104 p
Available from Univ. Microfilms: HC $5.20/MF $3.00 Order No. 67-9657

The electron gas is described in terms of quantum mechanical one- and two-particle distribution functions. The random phase approximation can be used to calculate the two-particle distribution for a homogeneous electron gas as a functional of the one-particle distribution. It is shown that the random phase approximation yields the lowest order term in an expansion in powers of q_{TF}/p_F or λ/L_D where q_{TF} is the Thomas–Fermi wave number, p_F is the Fermi wave number, λ is the thermal wavelength, and L_D is the Debye wavelength. A straightforward calculation of the two-particle distribution function is quite complex even within the framework of the random phase approximation. However, some of the mathematics involved can be simplified by using a "test particle" approach. It is shown that the "dressed test particle" concept introduced by Rostoker for classical plasmas can also be applied to quantum mechanical systems. Dissert. Abstr.

N68-29697 Harvard Univ., Boston, Mass.
TOTAL SCATTERING CROSS SECTIONS IN MOLECULAR BEAMS
Eric Arni Gislason (Ph.D. Thesis) 1967 192 p
Available from Univ. Microfilms: HC $8.80/MF $3.00 Order No. 67-11250

Total cross sections were measured for scattering of velocity selected beams of alkali halide molecules KCl, CsCl, and CsBr by Kr, Xe, HBr, and CH_3I. The results indicate that rotationally inelastic transitions produced by the angle-dependent dipole-dipole potential dominates the scattering provided the rotational spectra of the two colliding molecules overlap strongly. The velocity dependence of the alkali halide-CH_3I scattering is much weaker than for the elastic scattering of alkali halide-rare gas systems. Because of the finite angular resolution of the apparatus, it was necessary to correct the results described above. This requires a knowledge of the small angle scattering for dipole-dipole systems. Approximate formulas were obtained using a semiclassical analysis along with a Born approximation for the scattering matrix. Resolution corrections were then evaluated for dipole-dipole systems. Dissert. Abstr.

N68-29704 Michigan State Univ., East Lansing.
NUCLEAR QUADRUPOLE RESONANCE STUDY OF CHARGE TRANSFER COMPLEXES
James Austin Ryan (Ph.D. Thesis) 1967 240 p
Available from Univ. Microfilms: HC $10.80/MF $3.10 Order No. 67-10554

A nuclear quadrupole resonance spectrometer of the Dean type was constructed both for frequency and field modulation and for display of the signal either on an oscilloscope screen or by use of a lock-in amplifier on a recorder. New chlorine quadrupole resonances were found in the following charge-transfer complexes: $SbCl_5 \cdot POCl_3$, $FeCl_3 \cdot POCl_3$, $TiCl_4 \cdot 2POCl_3$ and $(TiCl_4 \cdot POCl_3)_2$. These resonances were observed both at liquid nitrogen temperature and at room temperature, although in all cases the resonances due to the chlorine nuclei of $POCl_3$ in the complex molecule disappear below room temperature. A study of the temperature dependence of the resonance due to the "axial" chlorines of the $SbCl_5$ part of $SbCl_5 \cdot POCl_3$ indicated a possible phase transition between 77°K and 165°K. An estimate of the contribution of the solid-state effect to the observed resonance frequencies was made assuming that the partially charged atomic sites in the lattice may be replaced by point charges, which make the dominant contribution to the measured field gradients. A comparison indicated that the Sternheimer antishielding factor for chlorine is much smaller than the value previously used by other workers. Dissert. Abstr.

N68-29717# Junta de Energia Nuclear, Madrid (Spain). Division de Fisica.
MAGNETIC ANALYSIS OF THE V^{51} (D,P) V^{52} [ANALISIS MAGNETICO DE LA REACCION ^{51}V (D,P) ^{52}V]
J. M. Bolta Alandete Jul. 1966 28 p refs In SPANISH; ENGLISH summary
(JEN-181-DF/I-55) CFSTI: HC $3.00/MF $0.65

We have analysed the protons emitted after bombardment of a Vanadium target by deuterons of 10.1 MeV using a multichannel magnetic spectrometer of high resolving power, with which we measured 24 different scattering angles covering the angular interval from 5° to 175°. The characteristic variation of energy with angle enable us to identify 38 groups of protons corresponding to the ground state and 37 excited stated of ^{52}V up to an energy of 3.66 MeV; the values obtained are in perfect agreement with previously published results and seven new levels are quoted for the first time. We have also calculated the experimental angular distributions for all these levels. These distributions which are, in general, well-defined over a wide angular interval, have been analysed using distorted-wave theory (DWBA), except for a few cases in which the cross-section was very small. Thus we have obtained reduced widths and the value of the angular momentum with which the neutron is captured for the corresponding levels. Our results show general agreement with the nuclear shell model according to which the first free levels for the capture neutrons are $2p_{3/2}$, $1f_{5/2}$ and $2p_{1/2}$. Author ESRO)

N68-29729 California Univ., Berkeley.
DETERMINATION OF THE NEUTRON-NEUTRON SCATTERING LENGTH
Edward Shield (Ph.D. Thesis) 1967 71 p
Available from Univ. Microfilms: HC $4.00/MF $3.00 Order No. 67-11664

Measurements on the reaction T(d,He^3)2n at 32.7 MeV incident deuteron energy have been used to determine the n-n scattering length. Watson's theory of final state interactions provides a theory with which the experimental data giving the number of He^3 at 6 and 8 deg versus energy can be compared. Comparison is made with number of He^3 near the maximum energy in which case the neutrons go off with little relative energy under the influence of a final state s-wave interaction. The best fit of the data to theory gives $a_{nn} = -16.1 \pm 0.1$ F. The applicability of this method is proved by measurements on the reaction He^3(d,T)2p which give a value for a_{pp} equal to the accepted value within the experimental errors. Comparisons of results with other measurements of a_{nn} are given. Dissert. Abstr.

N68-29733# American Meteorological Society, Boston, Mass.
FRACTIONAL PARENTAGE COEFFICIENTS OF A CONFIGURATION WITH SEVERAL SHELLS[GENEALOGICHESKIE KOEFFITSIENTY KONFIGURATSII S NESKOL'KIMI OBOLOCHKAMI]
I. B. Levinson Aug. 1966 23 p refs Transl. into ENGLISH from Lietuvos TSR Mokslu Akad. Darbai, Ser. B (USSR), v. 4, no. 12, 1957 p 17-31
(Contract AF 19(628)-3880)
(T-R-644; AD-669185)

The wave functions of a configuration consisting of an arbitrary number of shells are formulated by coupling of the momenta of the antisymmetric wave functions of the individual shells and by subsequent antisymmetrization of the resulting wave function through exchanges of particle coordinates among the shells. The fractional parentage coefficients of these wave functions are expressed as the product of one or two fractional parentage coefficients per individual shell times the matrix element of the matrix of transformation between the various angular-momentum coupling schemes. Formulas are derived for calculating the matrix elements of the symmetric operators. Author (TAB)

N68-29734 California Univ., Los Angeles.
POLARIZED PROTON SCATTERING FROM OXYGEN AT 40.0, 37.1, 34.2, 30.4, 27.8 AND 24.2 MEV
Hudson Bluford Eldridge (Ph.D. Thesis) 1967 115 p
Available from Univ. Microfilms: HC $5.60/MF $3.00 Order No. 67-9649

The polarized proton beam from a cyclotron has been used to measure the angular dependence of the left-right scattering asymmetry for oxygen. The peaks in the scattered proton spectra arising from elastic scattering from oxygen and hydrogen and inelastic scattering from oxygen were resolved by seeking a minimum x^2 fit between the measured pulse height distribution and an assumed theoretical distribution. For the theoretical pulse height distribution, gaussian peaks were assumed for the groups scattered elastically from oxygen while the background function chosen depended upon both energy and scattering angle. The angular distributions of the asymmetry for each incident proton energy are presented along with the systematic and statistical errors. Dissert. Abstr.

N68-29736 Case Inst. of Tech., Cleveland, Ohio.
THE CONCEPT OF LOCALIZATION IN THE INDEPENDENT PAIR MODEL OF ELECTRONIC STRUCTURE AND ITS APPLICATION TO THE BERYLLIUM ATOM
Eduardo Vicente Ludena (Ph.D. Thesis) 1966 91 p
Available from Univ. Microfilms: HC $4.80/MF $3.00 Order No. 67-11557

For several years investigators have argued that the natural framework for the discussion and calculation of electron correlation energies is based on the concept of localized electronic wavefunctions. This viewpoint is analyzed and adopted here as a basis for deriving equations for a correlated trial wavefunction within the context of the independent pair model. Arguments based on the localization concept justify the neglect of coupling matrix elements which appear in the Bethe-Goldstone equations. These equations are applied to the calculation of the correlation energy of the beryllium atom. Approximate localized geminal functions are found. The one-electron functions are selected to be the Edmiston-Ruedenberg localized orbitals. An expansion of the correlation term up through powers of r_{12}^3 gives 98.5% of the total correlation energy of Be. Dissert. Abstr.

N68-29757 Case Inst. of Tech., Cleveland, Ohio.
NUCLEAR MAGNETIC RESONANCE STUDIES OF LIQUID AMMONIA
Stephan Bernard Marks (Ph.D. Thesis) 1966 63 p
Available from Univ. Microfilms: HC $3.60/MF $3.00 Order No. 67-11559

Anhydrous liquid ammonia was prepared and the PMR spectrum was recorded as a function of temperature from −72°C to +34°C. The line shapes were shown to be given by the equation derived by Pople and the transitions connecting ^{14}N spin states and the $^{14}N-{}^{1}H$ coupling constant were measured. The Bloch equations pertinent to $^{14}NH_3$ were extended to include chemical exchange processes. A method of extracting values of the rate constant for the exchange process was developed. Solutions of KNH_2 in NH_3 and in partially deuterated NH_3 were prepared by catalytic decomposition of potassium-ammonia solutions. The kinetics of the ammonia-amide proton exchange were studied as a function of temperature and concentration. Potassium−$^{14}NH_3$, lithium−$^{14}NH_3$, and potassium−$^{15}NH_3$ solutions were prepared and the nuclear relaxation of these solutions was investigated. Dissert. Abstr.

N68-29758 University of Southern Calif., Los Angeles.
ABSORPTION AND SCATTERING OF THERMAL RADIATION BY A CLOUD OF SMALL PARTICLES
Anthony Robert Nagy, Jr. (Ph.D. Thesis) 1967 174 p
Available from Univ. Microfilms: HC $8.00/MF $3.00 Order No. 67-10771

An experimental investigation was made of the absorption and scattering of thermal radiation by a cloud of small particles in a plane-parallel enclosure. The particles, which were in the micron-size range, were spherical in shape and were made of aluminum oxide and of glass. They were separated into narrow-size ranges by elutriation techniques. Infrared transmisssion measurements were made with a Bekman IR-2A spectrometer with a test cell the shape of a right circular cylinder, 2.39 cm diameter, and 1.43 cm long, using optical windows made of arsenic trisulphide. A straight line was obtained when the logarithm of the transmissivity for the collimated source was plotted against the particle population density. The two-flux theory of Shuster and Kubelka and Munk was used to correlate the diffuse measurements. Dissert. Abstr.

N68-29760* American Meteorological Society, Boston, Mass.
CALCULATION OF THE SPLITTING OF A TRIPLET TERM OF THE POSITIVE ION OF NITROGEN [TRIPLETINIO TERMO SUSKILIMO SKAICIAVIMAS TEIGIAMO AZOTO IONO ATVEJU]
T. Strockyte and A. Jucys Oct. 1966 6 p refs Transl. into ENGLISH from Vilniaus Univ., Mokslo Darbai (Lithuanian SSR), no. 6, 1956 p 39–42
(Contract AF 19(628)-3880)
(T-L-13; AD-669160)

It was previously shown (see CFSTI reports TT-61-19029 and TT-64-19580) that Fock self-consistent-field orbitals permit rather accurate theoretical evaluation of the splitting of terms, while analytic orbitals are suitable only if the progressions of the splitting follow in isoelectronic sequences. In the present paper, results are presented for the theoretical splitting of the triplet term in the ground configuration of the positive ion of nitrogen. TAB

N68-29765 California Univ., San Diego.
CORRELATION EFFECTS IN SOLID HELIUM THREE
Jobst Herbert Frohberg (Ph.D. Thesis) 1967 142 p
Available from Univ. Microfilms: HC $3.00/MF $0.65 Order No. 67-10294

A detailed investigation is made of the effects of two-particle correlation on the ground state energy of solid He^3 at 0°K. A product of single particle wavefunctions and two particle correlation functions is chosen as a variational wave-function. The correlation function depends on the relative distance between the two particles, as well as the separation of the lattice sites at which they are localized. The single particle wavefunctions are chosen to be gaussians that are spherically symmetric about their respective lattice sites, and whose range enters as a parameter into the calculations. The ground state energy is expanded in a cluster series, which contains terms due to the localization of the particles and not present in the cluster expansion for a liquid or gas. The usual minimization principles are then applied to the first two terms of the cluster expansion to derive a set of self-consistent equations for the correlation function. Dissert. Abstr.

N68-29771 Rice Univ., Houston, Tex.
STUDIES OF THE MOTION OF AN ELECTRON IN A MAGNETIC FIELD IN A CRYSTAL LATTICE
Eric Trent Lane (Ph.D. Thesis) 1967 71 p
Available from Univ. Microfilms: HC $4.00/MF $3.00 Order No. 67-13095

Three types of calculations bearing on the behavior of metallic electrons in a magnetic field have been carried out. To find the representation most suitable to the treatment of an electron in a magnetic field in a crystal lattice, exact solutions for the free electron in a uniform magnetic field are obtained in rectangular and in cylindrical coordinates in both the coordinate representation and in the wave-vector or momentum representation. The velocity and orbit center variables are found to be the most useful set of independent, conjugate variables to treat the problem of the electron in a magnetic field in an arbitrary potential. These variables allow an arbitrary, three-dimensional periodic lattice potential to be treated as a perturbation on the wave-functions of the electron in a magnetic field. A simple periodic potential is treated in detail. Dissert. Abstr.

N68-29779 Yale Univ., New Haven, Conn.
REACTIONS OF HOT TRITIUM ATOMS WITH METHANE AND HYDROGEN
David Allen Seewald (Ph.D. Thesis) 1967 121 p
Available from Univ. Microfilms: HC $6.00/MF $3.00 Order No. 67-10716

The reaction of recoil tritium with methane has been exhaustively re-examined in a search for limitations of the recoil technique. Previously noted discrepancies in hot HT yields at high moderation were traced to the use of helium as a moderator. In accordance with predictions of the adiabatic principle, it appears

that in pure or nearly pure helium, not all tritium atoms are neutralized—causing small ionic contributions to what are normally regarded as hot atom products. No such effects occur if moderators of lower ionization potential are used. The techniques thus developed made possible the exploration of the simple exchange reaction of atomic and molecular hydrogen over all possible energies. Accordingly, reactions of hot tritium with H_2, D_2 and HD were studied. It was found that tritium preferentially reacted with hydrogen when reacting with an equimolar deuterium-hydrogen mixture, while reaction with deuterium was favored in the reaction of tritium with HD. Dissert. Abstr.

N68-29781
NUMBER OF SCATTERINGS IN THE DIFFUSION OF PHOTONS. 2
V. V. Sobolev 1968 9 p refs Transl. into ENGLISH from Astrofiz. (USSR), v. 2, no. 3, 1966 p 239–250
CFSTI: HC $3.00/MF $0.65

Formulas are obtained for governing the mean number of photon scatterings in a three-dimensional semi-infinite medium. The mean numbers of scatterings of a photon absorbed at a given place in a medium is determined, as are the mean numbers of scatterings of a photon when the medium is exposed to external radiation sources. For diffusely reflected photons, the mean number of scatterings can be found as a function of the angles of incidence and reflection. M.W.R.

N68-29831# Argonne National Lab., Ill.
SOME PECULIARITIES OF MOTION AND HEAT TRANSFER OF PARTICLES IN A PULSATING GAS CURRENT
A. L. Parnas Mar. 1968 8 p refs Transl. into ENGLISH from the book "Issledovanie Teplo-i Massoobmena v Teknologicheskikh Protessakh i Apparatakh" Minsk, Nauka i Tekhn., 1966 p 33–36
(ANL-Trans-591) CFSTI: HC $3.00/MF $0.65

A theoretical investigation of the effects of pulsating gas flow on the motion and heat transfer of particles in fluidized beds is presented. NSA

N68-29840# International Centre for Theoretical Physics, Trieste (Italy).
SUPERCONVERGENT DISPERSION RELATIONS AND I=2 ELECTROMAGNETIC MASS DIFFERENCES OF HADRONS
S. N. Biswas (Delhi Univ.), S. K. Bose (Delhi Univ.), K. Datta (Delhi Univ.), J. Dhar (Delhi Univ.), Yu. V. Novozhilov (Leningrad Univ.) et al Vienna Intern. Atomic Energy Agency Jun. 1967 14 p refs Submitted for publication
(IC-67-48) CFSTI: HC $3.00/MF $0.65

Explicit calculations have been presented for the I=2 type electromagnetic mass difference between particles of a given isomultiplet using the superconvergent dispersion relation approach suggested by Harari. We obtain in particular the electromagnetic mass differences between (1) $\pi^+ - \pi^0$ (2) $\rho^+ - \rho^0$ (3) $\Sigma^+ + \Sigma^- - 2\Sigma^0$ (4) $N^{*+} + N^{*-} - 2N^{*0}$ and (5) $Y_1^{*+} + Y_1^{*-} - 2Y_1^{*0}$. The agreement of our results with experiments is excellent. Author (ESRO)

N68-29842# International Centre for Theoretical Physics, Trieste (Italy).
CHIRAL SYMMETRY, SUPERCONVERGENCE AND SUN RULES FOR SCATTERING AMPLITUDES
D. S. Narayan (Tata Inst. of Fundamental Res.), R. P. Saxena (Delhi Univ.), and Premp. Srivastjava (Univ. Federal do Rio de Janeiro) Vienna, Intern. Atomic Energy Agency 22 Jun. 1967 8 p refs Submitted for publication
(IC-67-47) CFSTI: HC $3.00/MF $0.65

Generalizing an idea of chiral symmetry being exact in an asymptotic limit, we obtain superconvergent sum rules for suitable combinations of scattering amplitudes. The predictions of the sum rules are compared with experiment. Author (ESRO)

N68-29843# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
FACTORIZATION AND CONSTRAINTS IN REGGE-POLE THEORY
A. Capella, A. P. Contogouris, and J. Tran Thanh Van May 1968 13 p refs
(Rept.-68/14) CFSTI: HC $3.00/MF $0.65

Using non-group theoretical methods, the behavior at momentum transfer $\sqrt{t} \to 0$ of the Regge residue functions ${}^{\beta}\lambda_3\lambda_4,\lambda_1\lambda_2{}^{(n)}$ of the t-channel reaction $1 + \bar{2} \to \bar{3} + 4$ is determined. The solution is minimal in the sense that for a trajectory α (t) of known quantum numbers it gives the most singular behavior of ${}^{\beta}\lambda_3\lambda_4,\lambda_1\lambda_2{}^{(n)}$ compatible with analyticity requirements and the factorization theorem. Using the solution, it is shown that at least in the cases (1) $N + \bar{N} \to N + \bar{N}$ (N = nucleon), (2) $N + \bar{N} \to \bar{3} + 4$ where 3 and 4 are particles of arbitrary spin and $m_3 \neq m_4$, (3) $m_1 \neq m_2$ and $m_3 \neq m_4$, can satisfy all the kinematical constraints (=conspiracy relations) at $t = 0$ to all orders in $s = (p_1 + p_3)^2$; but in order to do this a classification and certain relations between the involved trajectories were imposed which are identical to those obtained by group theoretical methods. In particular, for a situation which corresponds to the group theoretical class 3, parity doubling was deduced. S.C.W.

N68-29879*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
BEHAVIOR OF THE IONIZATION CROSS SECTION IN HIGH ENERGY ELECTRON–HYDROGENIC ATOM COLLISION
Kazem Omidvar Jul. 1968 27 p refs
(NASA-TM-X-63288; X-641-68-294) CFSTI: HC $3.00/MF $0.65
CSCL 20H

The ionization cross section per unit range of the energy ϵ of the ejected electrons for the collision of an incident charged particle of high energy E with an atomic system is given by $dQ/d_\epsilon = E^{-1}[A(\epsilon)\ln E + B(\epsilon)]$, where A and B are functions of ϵ, and the total cross section is given by $Q = E^{-1}[A_T \ln E + B_T]$. The coefficients $A(\epsilon)$ and $B(\epsilon)$ for the particular case of the atomic hydrogen are derived analytically as an expansion with respect to $k = \sqrt{\epsilon}$. The expansion converges for all values of k. The coefficients of the first two leading terms of the expansion of $dQ/d\epsilon$ with respect to ϵ or $1/\epsilon$ when ϵ is small or large is found. A relationship for the average energy of the ejected electrons is given. Different features of the high energy impact ionization and certain connections between the ionization and the discrete level excitation are discussed. Author

N68-29904 Denver Univ., Colo.
ESTIMATION OF THE TOTAL ENERGY OF THE BERYLLIUM HYDRIDE MOLECULE
Robert Chang-chun Lao (Ph.D. Thesis) 1968 105 p
Available from Univ. Microfilms: HC $5.20/MF $3.00 Order No. 67-3946

One of the very simplest of polyatomics is BeH_2, assumed linear symmetric from simple hybridization ideas. We have estimated the total energy of the gaseous molecule by means of the following sequence of steps: (1) Using Slater type orbitals, compute the LCAO-MO energy in a self-consistent field. The resultant three-integrals are to be computed with no approximations. Search internuclear distance. (2) Estimate the SCF error down to the Hartree–Fock limit, the latter being the best possible energy with a single determinant wavefunction. (3) Estimate the correlation energy down to the exact nonrelativistic energy. (4) Estimate the relativistic correction; this is by far the largest of several quite minor corrections. Dissert. Abstr.

N68-29908 California Univ., San Diego.
ELECTROPRODUCTION IN PI MESONS AT HIGH ENERGY AND LARGE MOMENTUM TRANSFER

Robert Chester Vik (Ph.D. Thesis) 1967 43 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-11524

The inelastic scattering of an electron by a nucleon, accompanied by creation of a single pi meson (pion electroproduction) is considered as a function of k^2, the square of the three dimensional momentum transfered from the electron to the final pion nucleon system. At energies high enough that the pion nucleon center of mass energy is above the region of the N* (1238) resonance no complete cross section calculation exists, largely because the presence of inelastic channels makes the calculation difficult. However the effect of an important set of one particle exchange diagrams can be evaluated, and it is proposed that they provide a way of examining the qualitative behavior of the electroproduction cross section as a function of k^2. The cross sections in several partial waves, due to these diagrams, are evaluated and are compared with published experimental results at several energies. Dissert. Abstr.

N68-29909 Delaware Univ., Newark.
A THEORETICAL STUDY OF IMPURITY STATES, IMPURITY PAIRS, AND ENERGY TRANSFER IN ZnS AND RELATED MATERIALS
John Clifford Shaffer (Ph.D. Thesis) 1966 71 p
Available from Univ. Microfilms: HC $4.00/MF $3.00 Order No. 67-11733

The energy levels and transition probabilities for donor-acceptor pairs are considered. A technique for calculating the energies of the localized states of transition metal impurity, d-electron configurations in ZnS is presented. Finally, a mechanism for energy transfer from donor-acceptor pairs to the localized levels of transition metal and rare earth impurities is proposed and its importance explored. The calculations for the donor-acceptor pair system are done in an effective-mass approximation and criteria for their validity noted. They are applied to ZnS and GaP and the differences in the pair emission in these two materials are clarified. The transition metal levels are computed using a tight-binding, ionic model of ZnS and the results are compared with and judged on the basis of the known properties of ZnS:Mn and ZnS:Cr. The application of the method to other materials and impurities, such as rare earths is discussed. Dissert. Abstr.

N68-29937 Utah Univ., Salt Lake City.
TRANSVERSE WAVE INTERACTIONS BETWEEN ROTATING ELECTRON BEAMS AND WAVE GUIDES
Richard La Verl Schriever (Ph.D. Thesis) 1967 155 p
Available from Univ. Microfilms: HC $7.20/MF $3.00 Order No. 67-12357

Application of a general coupled-mode theory to specific rotating beam configurations is made. The dispersion properties of the normal beam modes and normal circuit modes are considered to find possible cases of synchronism which may result in favorable interactions. The coupled-mode equations are solved for important cases with the help of simplifying approximations to find the propagation constants of the waves which can exist in the system. Application of boundary conditions at the input to the interaction circuit completes the interaction description. An expression for gain for the wave guide circuit mode is defined. These calculations show that both backward-wave oscillation and traveling-wave amplification are possible in this type of device, but that the backward-wave interaction dominates. Dissert. Abstr.

N68-29944 Syracuse Univ., N. Y.
CURRENTS AND CURRENT COMMUTATORS: AN APPLICATION TO SCATTERING PROCESSES AND NON-LEPTONIC DECAYS
Michael George Gundzik (Ph.D. Thesis) 1966 191 p
Available from Univ. Microfilms: HC $8.80/MF $3.00 Order No. 67-9306

A method for calculating the S-matrix elements of a number of physical processes is developed and applied to the non-leptonic decays of hyperons as well as baryon-meson and meson-meson scattering. The S-matrix element in question is extrapolated to an off-mass-shell point and simplified by the use of the partially conserved axial vector current hypothesis and an algebra of the weak vector and axial vector currents under equal time commutation based on the quark model. In the application to hyperon non-leptonic decays the parity violating and parity conserving parts of the amplitude are studied in the framework of the group $SU(6)_w$. The nine S-wave and twelve P-wave decays of the baryons in the 56 dimension representation of $SU(6)_w$ are found to be determined by four parameters, one of which relates the S and P-wave decays. The method of off-mass-shell extrapolation used in the non-leptonic decays is extended first to the case of forward meson-baryon and meson-meson scattering for the calculation of the S-wave scattering lengths for the πN, KN, and $K\pi$ systems. Then this is generalized to the case of nonforward elastic scattering for the calculation of the S and P-wave low energy parameters and applied to the πN and KN systems. Dissert. Abstr.

N68-29963# Laboratoire des Physique Theorique et des Hautes Energies, Orsay (France).
THE ASYMPTOTIC BEHAVIOR OF THE NUMBER OF BOUND STATES OF A GIVEN POTENTIAL IN THE LIMIT OF LARGE COUPLING
K. Chadan Jun. 1968 16 p refs
(Rept.-68/16) CFSTI: HC $3.00/MF $0.65

Given a potential $V(r)$, which is assumed to be everywhere positive, non-increasing as r increases, and for which $\int_0^\infty \sqrt{V(r)}\,dr < \infty$, it is shown that the number of bound states of $g\,V(r)$ in any angular momentum state l has the asymptotic behavior $n_l(g) \approx \pi^{-1} \int_0^\infty \sqrt{V(r)}\,dr\,\sqrt{-g}$ in the limit $g \to -\infty$. On the basis of several examples, it seems that the above theorem is valid even if $V(r)$ is only positive, without being everywhere non-increasing. Author

N68-29989*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ASYMPTOTIC RELATIONS BETWEEN THE THOMAS-FERMI-DIRAC AND THOMAS-FERMI ATOM MODELS. 2. EXTENSION OF THE CASE OF LOW ATOMIC NUMBER
R. E. Hartle and J. J. Gilvarry (NASA, Ames Research Center) Jul. 1968 34 p refs
(NASA-TM-X-63284; X-615-68-259) CFSTI: HC $3.00/MF $0.65 CSCL 20J

The asymptotic relation between the pressure with exchange in the Thomas–Fermi–Dirac atom model and the corresponding pressure without exchange on the Thomas–Fermi model for the case of low atomic number considered in the first paper of this series is generalized by including a correction corresponding to the first-order Coulomb contribution to the energy of the atom, rather than the kinetic energy of the electrons alone. All terms yielded by the asymptotic solution of March for the Thomas–Fermi–Dirac equation in the limit of small atom radius are included, and the extension of results on the basis of the general asymptotic solution of Rijnierse in this limit is indicated. The expression for the radius of an isolated Thomas–Fermi–Dirac atom for low atomic number obtained previously is extended to include a term corresponding to the Coulomb correction of first order, and compared with a similar result of Jensen. Asymptotic relations between thermodynamic functions (the energy, the compressibility, and parameters associated with the energy and equation of state) on the two models for low atomic number as given previously are extended similarly. Comparison of the extended asymptotic relations between the pressures on the two models is made with numerical results obtained by direct solution of the Thomas–Fermi–Dirac equation. Author

N68-30001*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

FISSION NEUTRON ATTENUATION IN LITHIUM-6, NATURAL LITHIUM HYDRIDE, AND TUNGSTEN

Gerald P. Lahti Washington Aug. 1968 24 p refs

(NASA-TN-D-4684) CFSTI: HC $3.00/MF $0.65 CSCL 18G

A fission-spectrum neutron-dose-rate-attenuation curve was computed by the discrete-ordinates method for Li^6H and natural LiH for penetration depths up to 139.5 cm. Results were compared with a recent Monte Carlo calculation for natural LiH. A single value for an energy-independent-neutron-removal cross section for Li^6 and natural Li in LiH was deduced for use in an Albert–Welton dose-attenuation kernel but is accurate for only a given range of penetration. The validity of fast-neutron-removal theory was demonstrated for the cases of W followed by LiH. From this penetration data, a neutron-removal cross section for W was calculated. Author

N68-30046# Polish Academy of Sciences, Cracow.

A SHORT REVIEW OF SOME MOSSBAUER EFFECT EXPERIMENTS FOR IMPURITY ATOMS [KROTKI PRZEGLAD EKSPERYMENTOW MOSSBAUEROWSKICH DLA ATOMOW DOMIESZKOWYCH]

J. Bara and A. Z. Hrynkiewicz Feb. 1968 23 p refs Submitted for publication

(Rept.-590/PL) CFSTI: $3.00

The paper contains a short review of the experimental results of the Debye–Waller factor and isomer shift measurements for impurity atoms. The experimental data for the Debye–Waller factors might be described theoretically in the Debye approximation of the crystal lattice, under the assumption that force constants for the host-impurity atoms are almost the same as for host-host atoms. Interesting correlations between the isomer shifts for impurity atoms and various properties of solids are pointed out. Author

N68-30056# Nuklearni Institut Jozef Stefan, Ljubljana (Yugoslavia).

INFORMATION ABOUT THE RANDOM MOLECULAR MOTION FROM THE INFRARED AND RAMAN SPECTROSCOPY, NUCLEAR MAGNETIC RESONANCE EXPERIMENTS AND INELASTIC NEUTRON SCATTERING

G. Lahajnar Feb. 1968 14 p refs

(NIJS-R-521) CFSTI: HC $3.00/MF $0.65

An assessment is presented on the four different methods of studying molecular reorientation processes. It is concluded: (1) Infrared and Raman spectroscopy techniques give the most direct insight into molecular reorientation processes as the complete correlation functions are obtained by the Fourier transform of infrared and Raman band shapes. The main disadvantage is cited as the other effects, beside molecular motion, which contribute to the bandwidth such as the anharmonicity. (2) The pulsed nuclear magnetic resonance methods offer only the spectral density at the resonant frequency. In principle, the correlation function can be explored by varying the magnetic field in a wide range, but the experimental difficulties are great. (3) The inelastic neutron scattering method has the advantage of providing information concerning frequencies from the whole k-region. Author

N68-30076# Polish Academy of Sciences, Cracow. Inst. of Nuclear Physics.

NEUTRON DIFFRACTION STUDIES OF α-FeOOH

S. Krasnicki, H. Rzany, A. Wanic, A. Szytula (Jagellonian Univ.), J. Totrovic (Inst. za Nuklearne Nauke /Boris Kidric/, Vinca, Jugoslav.) et al Nov. 1967 17 p refs Submitted for publication

(Rept.-578/PS) CFSTI: $3.00

Goethite (α-FeOOH) of a mineralogical and synthetic origin (α-FeOOH of natural isotopic composition and α-FeOOD) was investigated. Measurements were carried out by means of the neutron spectrometer installed in front of the reactor, using the monochromatic neutron beam of $\lambda = 1.12$ Å. Some powder diffraction patterns in the temperature range from −190° to +120°C were measured. The obtained coordinates for all atoms (including those for hydrogen) in the unit cell are given. The existence of anti-ferromagnetic spin ordering in temperatures below +80°C was neutronographically checked. The model in which spins of iron ions are aligned parallel to the b-axis was verified. Author

N68-30173# Aerospace Research Labs., Wright-Patterson AFB, Ohio.

TABLE OF HARTREE-FOCK SELF CONSISTENT FIELD WAVE FUNCTIONS WITH EXCHANGE, SUPPLEMENT 4

T. K. Krueger, W. L. Mc David, and S. J. Czyzak Feb. 1968 442 p refs

(ARL-68-0026; AD-669355)

A table is presented of the Hartree-Fock wave functions for various atoms and ions mainly of astrophysical interest having atomic numbers ranging from 13 to 86. Also included in the table are the one-electron energy parameters and the relativistic and spin-orbit energy corrections. Author (TAB)

N68-30207# Oak Ridge National Lab., Tenn. Reactor Div.

A STUDY OF THE EFFECT OF EMPTY CHANNELS ON THE NEUTRON DIFFUSION COEFFICIENT IN GRAPHITE

Leonard L. Bennett (M.S. Thesis—Tenn. Univ., Knoxville) Mar. 1968 71 p refs

(Contract W-7405-ENG-26)

(ORNL-TM-2085) CFSTI: HC $3.00/MF $0.65

The effect on the neutron diffusion coefficient of neutron streaming along empty channels is discussed using steady-state flux traverse and pulsed-neutron measurements. These measurements were made in the moderator structure of the Experimental Gas-Cooled Reactor with no control rods in the assembly and also with two different patterns of full length control rods. Using one-velocity diffusion theory, the axial component of the thermal neutron diffusion coefficient for each experimental configuration was obtained from the experimental results. The theory of Behrens was used to calculate the value for the diffusion coefficient parallel to the empty channels. This calculation was made for the empty moderator assembly with no control rods inserted. These results indicate that Behrens' formulas for the parallel neutron streaming corrections are quite good for this case. Author (NSA)

N68-30210*# Scripta Technica, Inc., Washington, D. C.

CONSEQUENCES OF DIRAC'S POSITRON THEORY [FOLGERUNGEN AUS DER DIRACSCHEN THEORIE DES POSITRONS]

W. Heisenberg and H. Euler NASA Jul. 1968 18 p refs Transl. into ENGLISH from Z. Physik (Berlin), v. 38, 1936 p 713–742

(Contract NASw-1694)

(NASA-TT-F-11829) CFSTI: HC $3.00/MF $0.65 CSCL 20J

As a consequence of Dirac's positron theory one must modify Maxwell's equations for the vacuum since any electromagnetic field can produce pairs. These modifications are computed for the case when physical electrons and positrons are absent and when the field does not change appreciably over one Compton wavelength. For fields that are small compared to the critical field strength, the terms in the expansion of the Lagrangian describe scattering processes of light by light. The simplest term is already known from perturbation theory. Field equations for large fields are derived and are quite different from Maxwell's equations. The field equations are compared with those suggested by Born. Author

N68-30217# Southampton Univ. (England). Dept. of Aeronautics and Astronautics.

THE ELECTRONIC TRANSITION MOMENT OF THE N_2 FIRST POSITIVE SYSTEM (N 1 PG)

R. E. W. Jansson and B. E. Cunio Mar. 1968 18 p refs

(AASU-280) CFSTI: $3.00

Using improved values of the r-centroid the dependence of the electronic transition moment upon the r-centroid has been redetermined by computer regression from published experimental intensity data. It has also been determined by a similar method from published data on the decay of plasma afterglows. The two results obtained are in excellent agreement over their common ranges. The dependence has been put on an absolute basis by calculating the moment of the (0,0) transition. The oscillator strength of the (0,0) transition is calculated to be 2.190×10^{-3}. Author

N68-30225

NUMBER OF SCATTERINGS IN PHOTON DIFFUSION, PART 3

V. V. Sobolev [1968] 10 p refs Transl. into ENGLISH from Astrofiz. (USSR), v. 3, no. 1, 1967 p 5–16

CFSTI: HC $3.00/MF $0.65

Equations and formulas governing the mean number of scatterings of a photon in a plane layer of finite optical thickness are obtained. The following two types of radiation sources are considered: (1) radiation sources which are outside the medium; and (2) radiation sources within the medium. It is assumed that a photon absorbed at a given location is re-radiation (i.e., is scattered) with probability λ, or experiences true absorption with probability $1-\lambda$, where the quantity λ does not change in the medium. It is also assumed that the volume element scatters radiation isotropically and without frequency change. The mean number of scatterings of a photon absorbed at a given optical depth (and afterward diffusing into the medium) is determined, and the mean number of photon scatterings is found for particular kinds of radiation sources. Formulas obtained are applied to the case when the optical thickness of the considered plane layer is large. S.C.W.

N68-30228

NUMBER OF SCATTERINGS IN PHOTON DIFFUSION, PART 4

V. V. Sobolev [1968] 15 p refs Transl. into ENGLISH from Astrofiz. (USSR), v. 3, no. 2, May 1967 p 137–154

CFSTI: HC $3.00/MF $0.65

Diffusion of radiation with frequency redistribution in a plane layer of optical thickness τ_0 at the center of the spectrum line is considered. A total redistribution of radiation by frequencies is assumed, i.e., (1) the frequency of a photon which is scattered by a volume element is independent of the frequency of a photon incident on this volume, and (2) scattered photons may possess any frequency with a probability proportional to the absorption coefficient at this frequency. It is further assumed that the mean number of photon scatterings in a spectrum line depends essentially on the contour of the absorption coefficient. The mean number of scatterings of a photon absorbed at the optical depth τ at the center of the line is denoted by $Q(\tau, \tau_0)$. An equation is derived for determining the function $Q(\tau, \tau_0)$, and the properties of this function are elucidated. Special attention is paid to obtaining some inequalities permitting an estimate of the mean number of photon scatterings without solving the equation for the function $Q(\tau, \tau_0)$. In the case of a plane layer of large optical thickness, asymptotic formulas are found from these inequalities $Q(0, \tau_0)$ and $Q(\tau_0/2, \tau_0)$ for different absorption coefficient contours. Results are compared with those obtained from previously reported astrophysical and physical studies of radiation diffusion in a spectrum line. S.C.W.

N68-30239# Oak Ridge National Lab., Tenn. Neutron Physics Div.

MEASUREMENT OF THE NEUTRON FISSION AND CAPTURE CROSS SECTIONS FOR U^{233} IN THE ENERGY REGION 0.4 TO 2000 eV

L. W. Weston, R. Gwin, G. de Saussure, R. R. Fullwood (Rensselaer Polytech. Inst.), and R. W. Hockenbury (Rensselaer Polytech. Inst.) 8 Apr. 1968 64 p refs Prepared jointly with Rensselaer Polytech. Inst., Troy, N. Y.

(Contracts W-7405-ENG-26; AT(30-3)-328)

(ORNL-TM-2140) CFSTI: HC $3.00/MF $0.65

The neutron capture cross section and fission cross section for ^{233}U were measured simultaneously in the neutron energy range 0.4 to 2000 eV. A pulsed and collimated neutron beam was passed through a ^{233}U fission chamber placed at the center of a large liquid scintillator. Capture and fission events in the ^{233}U chamber were detected in the scintillator by means of their prompt gamma rays. Coincident signals from the fission chamber and liquid scintillator distinguished fission from capture events. Comparisons with previously published data, using similar and different methods, are given. Author (NSA)

N68-30246# Tokyo Univ. of Education (Japan).

ON THE ELECTROMAGNETIC MASS DIFFERENCES OF PION AND KAON

Kimio Miura [1968] 4 p refs

CFSTI: $3.00

Theoretically investigated is the possibility of explaining the electromagnetic mass difference of the boson field without applying the Feynman–Speisman theory (FS-theory) to quark model. It is shown that the electromagnetic mass difference of pi- meson may be understood by introducing VPγ and APγ vertices which corresponds to FS-theory applied to quark model. S.C.W.

N68-30266# United Kingdom Atomic Energy Authority, Culham (England). Culham Translations Office.

DETERMINATION OF THE EXISTENCE AND OF CERTAIN SPECIAL PROPERTIES OF TRIATOMIC MOLECULAR HYDROGEN JETS

F. M. Devienne and J. C. Roustan Nov. 1967 5 p ref Transl. into ENGLISH from Compt. Rend. Acad. Sci. (Paris), Ser. A and B, v. 263, 19 Dec. 1966 p 1389–1392

(CTO/453; NP-TR-1638) CFSTI: HC $3.00/MF $0.65

Molecular jets with different properties are obtained by the charge exchange of H_1^+, H_2^+, H_3^+ ion beams. The accommodation coefficients with respect to silver and the variation of the gain of a photoscintillator demonstrate the existence of H_3^0 molecules. Author (NSA)

N68-30268# United Kingdom Atomic Energy Authority, Culham (England). Culham Translations Office.

VARIATION OF THE COMPOSITION OF AN ION BEAM FROM A HIGH FREQUENCY ION SOURCE OPERATING WITH HYDROGEN AT DIFFERENT PRESSURES

F. Marcel Devienne and J. C. Roustan Nov. 1967 5 p Transl. into ENGLISH from Compt. Rend. Acad. Sci. (Paris), Ser. A and B, v. 262, 28 Feb. 1966 p 616–619

(CTO-452; NP-TR-1639) CFSTI: HC $3.00/MF $0.65

To investigate the percentage of H_3^+ as a function of the pressure in an ion source, a high-frequency source consisting of a cylindrical pyrex tube concentric with a coil connected to a high-frequency oscillator was used. One end carries the aluminum anode which is isolated from the plasma by an insulating disc. The gas is fed through a small duct located in the axis of the anode. The extraction of the ions at the other end of the tube is through an aluminum channel 11-mm long, 3.2 mm in dia. insulated from the plasma by a silica cylinder. The pressure in the pyrex tube is measured with a Pirani gage which in the case of hydrogen is

calibrated by means of a Macleod gage. To determine the percentage of the different ion types two different methods were used successively. NSA

N68-30272# Tokyo Univ. of Education (Japan). Dept. of Physics.
REGGE TRAJECTORY FOR THE NUCLEON–NUCLEON SCATTERING
Syurei Iwao and Akira Kawakami [1968] 25 p refs
(TUEP-68-12) CFSTI: HC$3.00/MF$0.65

The theory of complex angular momentum for the nucleon-nucleus scattering is discussed in detail. The relation between the Breit--Wigner multi-level formula and the Regge theory is given in a suitable form for the practical analysis. As an example the s- and p-wave elastic proton and neutron scatterings by ^{14}C and ^{14}N through the ^{15}N compound states are analysed by the Regge residue and the trajectory parameters. The energy dependence of the last quantity is compared with the purely theoretical study of the complex angular momentum for the Yukawa and the square-well potential. According to our analysis the Yukawa type is the most favorable one between the nucleon-nucleus interaction. The method of finding the strength of the potential is also suggested with some examples. Author

N68-30279# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science.
DELAYED GAMMA RAYS FROM FISSION Technical Report, 1 Aug. 1965–31 Jul. 1966
R. B. Walton and R. E. Sund Kirtland AFB, N. Mex. AF Weapons Lab. Oct. 1966 48 p refs
(Contract AF 29(601)-6837)
(GA-7348; AFWL-TR-66-122)

Measurements of the energy spectrum of delayed gamma rays from the neutron fission of Pu^{239} and U^{235} were performed with a NaI detector at a number of time intervals between 2 μsec and 80 sec. The data showed three new prominent gamma rays with energies of 205, 390, and 1330 keV; two unresolved gamma rays having energies of approximately 110 keV; and the six gamma rays with energies of 260, 460, 720, 850, 910, and 1250 keV which were observed in previous studies for $t > 50$ μsec after fission. Absolute intensities of the new gamma rays were obtained for the normalization factor derived from the relative intensities of the last six gamma rays and their previously determined absolute intensities. The 205-, 390-, and 1330-keV gamma rays probably result from the cascade decay of a single isomer which has a half life of 3.4± 0.4 sec and fission yields of 1.30± 0.32 and 0.63± 0.21 percent per fission of Pu^{239} and U^{235}, respectively. Half lives and yields were also obtained for the two 110-keV gamma rays, but the results are tentative because of uncertainties in the data. The fission yields, cascade gamma rays, and half lives of the isomer responsible for early delayed gamma rays have been summarized, and total intensities and energy emission rates presented as a function of time after fission. Author

N68-30316# Oak Ridge National Lab., Tenn.
INTRANUCLEAR CASCADES WITH MANY-PARTICLE INTERACTIONS
I. Z. Artykov, V. S. Barashenkov, and S. M. Yeliseev [1968] 32 p refs Transl. into ENGLISH from RUSSIAN Rept. JINR-P2-3604
(ORNL-TR-1800) CFSTI: HC$3.00/MF$0.65

Properties of many-particle interactions are studied by comparing the results of a cascade calculation with known experimental data on the interactions of pions and nucleons with various atomic nuclei in a wide energy range. The essential details of the calculations are described. NSA

N68-30325# California Univ., Livermore. Lawrence Radiation Lab.
ECSIL, A SYSTEM FOR STORAGE, RETRIEVAL, AND DISPLAY OF EXPERIMENTAL NEUTRON DATA
R. J. Howerton, W. J. Cahill, K. L. Hill, D. W. Thompson, and S. T. Perkins 11 Jan. 1968 94 p refs
(Contract W-7405-ENG-48)
(UCRL-50400, V. 1) CFSTI: HC$3.00/MF$0.65

A description of the Experimental Cross Section Information Library (ECSIL), a system written primarily in basic Fortran II for the storage, retrieval, and tabular or graphical display of experimental constants associated with neutron-induced nuclear reactions, is presented. Author (NSA)

N68-30350# Oak Ridge National Lab., Tenn. Neutron Physics Div.
ELASTIC AND INELASTIC SCATTERING OF PROTONS FROM Sn 120 FOR E_p = 20.6, 25.2, 30.6, AND 36.2 MeV: TABULATED DIFFERENTIAL CROSS SECTIONS
F. E. Bertrand, T. A. Love, N. Baron, (NASA, Lewis Res. Center), F. G. Perey, and J. K. Dickens May 1968 13 p refs
(Contract W-7405-ENG-26)
(ORNL-4252) CFSTI: HC$3.00/MF$0.65

Numerical values of differential cross sections for elastic and inelastic scattering of protons from ^{120}Sn for bombarding proton energies of 20.6, 25.2, 30.6, and 36.2 MeV are reported in tabular form. Inelastic scattering data are reported for the 1.17-MeV (2+) state at all incident energies, and for the 2.35-MeV (3^-) state at 2.06-, 25.2-, and 36.2-MeV incident energies. Cross sections were obtained at ≈5° intervals between laboratory angles of 15 and 110°. Author (NSA)

N68-30360# American Meteorological Society, Boston, Mass.
APPLICATION OF THE METHOD OF PARTIAL SEPARATION OF VARIABLES TO TWO EQUIVALENT p ELECTRONS [PRIMENENIE METODA NEPOLNOGO RAZDELENIYA PEREMENNYKH K DVUM EKVIVALENTNYM P-ELEKTRONOAM]
A. P. Yutsis Sep. 1966 26 p refs Transl. into ENGLISH from Zh. Eksperim. Teor. Fiz. (Moscow), v. 23, n. 4, 1952 p 357–370
(Contract AF 19(628)-3880)
(T-R-640; AD-669184)

A method is worked out for applying the partial separation of variables in the Fock-Veselov-Petrashen theory to atomic species with two valence p electrons, and there is an examination of the radial integrals that express the total energy of the species with partial separation of variables after integration over the spin and angular variables. Techniques are developed for computing the kinetic energy integrals and the integrals for exchange-type electrostatic energy. The numerical results of calculations with partial separation of variables are given for He, Li(+), and Be(++) in the configuration 2 p(2). Author (TAB)

N68-30366# California Univ., Berkeley. Lawrence Radiation Lab.
RADIATION SHIELDING FOR HIGH ENERGY MUONS: THE CASE OF A CYLINDRICALLY SYMMETRICAL SHIELD AND NO MAGNETIC FIELDS
D. Keefe and C. M. Noble Mar. 1968 55 p refs
(Contract W-7405-ENG-48)
(UCRL-18117) CFSTI: HC$3.00/MF$0.65

At proton accelerators with energies of tens of GeV and more, the shielding problems are dominated by the requirement of reducing the flux of muons to tolerable levels. This especially true for accelerators making extensive use of extracted proton beams. A technique for calculating the profile of the radiation shield for muons for a number of practical situations of interest, viz., beam loss in an internal target area, beam loss during transport of the

extracted proton beam down a long narrow pipe, and the case in which the extracted proton beam is dumped in a backstop is presented. Results obtained from a computer program are presented graphically for different possible shield materials—heavy concrete, iron, lead, and depleted uranium. The results span four orders of magnitude in muon flux normalized to the rate of interacting protons, so that one can obtain useful results by interpolation for a wide variety of beam loss and desired shielding situations. The primary proton energies used in the calculations—25, 70, 200, and 300 GeV—will be recognized as corresponding to the energies of proton accelerators at present either operating or under design. Author (NSA)

N68-30419# Aix-Marseilles Univ. (France). Faculte des Sciences.
CALCULATION OF RADIATIVE CORRECTIONS UP TO AND INCLUDING THE 6th ORDER [CALCUL DES CORRECTIONS RADIATIVES JUSQU'AU 6eme ORDRE INCLUS]
Jacques Calmet (Ph.D. Thesis) 19 Dec. 1966 86 p refs In FRENCH
(NP-17377)

The calculation of the perturbations were made within the framework of the self-interaction scalar field of the $\lambda\phi^3$ type. The study of the renormalization in functional formalism was made with all the results being given in momentum space. The graphic method used and the representation of the first six approximations of the finite part of the functional generator of the propagators are reported. The finite part of the contribution of the divergent graph of the second order is calculated, and the important properties are described. The contribution of the graphs pertaining to the 3rd, 4th, 5th, and 6th orders is calculated. The principle used is developed for the 4th order. The results obtained are tabulated. NSA

N68-30420# Brookhaven National Lab., Upton, N. Y.
STUDY OF NUCLEAR STRUCTURE WITH THE COSMOTRON
G. C. Phillips Jun. 1967 22 p refs Presented at the Symp. on Light Nuclei, Few Body Probl., and Nucl. Forces, Brela, Yugoslavia, 26 Jun.–5 Jul. 1967
(Contract AT(40-1)-1316)
(ORO-1316-57; CONF-670629-8) CFSTI: HC$3.00/MF$0.65

Some experiments in which a 1-GeV proton beam was used to probe nuclear structure are summarized. Specifically, the optical-model analysis of angular distributions for the elastic scattering of 1-GeV protons by ^{12}C, D, ^{4}He, H, and ^{16}O is discussed in detail. NSA

N68-30451# Bettis Atomic Power Lab., Pittsburgh, Pa.
A SOLUTION OF THE SLAB TRANSPORT PROBLEM
Lambros Lois Mar. 1968 57 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-TM-661) CFSTI: HC$3.00/MF$0.65

A solution of the slab one-dimensional problem with energy deg-radiation and arbitrary scattering is presented. An analytic solution of the one velocity, one region source free problem, is used as the basis for the entire problem. This solution is supplemented with an analytic solution for the one velocity, one region problem with distributed sources. They are extended to the many region problem and finally a slowing down scheme is added based on the group method. Code M0648 solves this problem; however, the slowing down matrix and group constants must be inputed. Program M0756 will solve the problem for gamma rays, but the slowing down matrix and the group cross sections are also calculated. Author (NSA)

N68-30464# Laboratoire de Physique Theorique et des Hautes Energies, Nice (France).
THRESHOLD THEOREMS FOR THE PHOTODISINTEGRATION OF THE DEUTERON
Michel LeBellac Apr. 1968 12 p refs
(N-TH-68/47) CFSTI: HC$3.00/MF$0.65

Low-energy theorems for the photodisintegration of the deuteron are derived from the kinematical singularities and constraints of helicity amplitudes and the usual analyticity assumptions. It is shown that the electric dipole amplitudes are given to zero and first order in the photon energy by the Born term, but that the magnetic amplitudes are given only to order zero. We discuss the error introduced by the extrapolation of results to threshold, we also give a brief comparison with the non-relativistic theory, and especially Siegert's theorem. Author

N68-30468# Bettis Atomic Power Lab., Pittsburgh, Pa.
NUMERICAL COMPARISON OF NEUTRON TRANSPORT APPROXIMATIONS FOR APPLICATION AT ENERGIES ABOVE 0.8 MeV (LWBR DEVELOPMENT PROGRAM)
L. B. Freeman and H. W. Ryals Apr. 1968 28 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-TM-690) CFSTI: HC$3.00/MF$0.65

The simplified P_1(SP_1) and modified P_2 (MP_2) transport approximations have been considered for use as practical nuclear design tools, replacing diffusion theory in the first few-group of a four-group scheme. Two numerical comparisons of two-dimensional systems indicate that SP_1 can be a satisfactory design tool for situations where the total cross section is slowly varying and the geometry is not too severe. The MP_2 approximation has certain computing advantages, but does not yield as uniform an improvement over P_1 as SP_1 yields. Author (NSA)

N68-30469# Princeton Univ., N. J. Palmer Physical Lab.
THE ISOTOPE SHIFT
G. E. Brown May 1968 11 p refs
(Contract AT(30-1)-937)
(PUC-937-314) CFSTI: HC$3.00/MF$0.65

A self-consistent description of the effect of adding a neutron to a nucleus is attempted using the Hartree–Fock formalism with a static density-independent nucleon–nucleon potential. The form of the interaction is then considered in more detail; specifically the use of reaction matrix formalism and a density-dependent potential in place of the static, density-independent potential in studied. It is shown that the density dependence of the effective interaction is quite important in the description of the isotope shift. NSA

N68-30476# Illinois Univ., Urbana. Dept. of Physics.
OXYGEN 16 (ALPHA, 2 ALPHA) CARBON 12 REACTION MECHANISMS NEAR 24 MeV
A. W. Parker, J. A. Allen, R. L. Yerke, and V. G. Stotland [1968] 58 p refs
(Contract N00014-67-A-0305-0005)
(AD-669924)

Measurements of the angular correlation between the two alpha particles emitted in the reaction 16O(alpha, 2 alpha)12C g.s. at incident energies near 25 MeV suggest that this reaction can be described in terms of both sequential and one-step knockout processes. The sequential reaction proceeds as inelastic alpha-particle scattering followed by alpha-particle decay of the excited levels of 16O to levels of 12C. Only the transitions to the ground state of 12C were studied. The most strongly excited levels were those at 11.1 MeV and 13.88 MeV. The strong energy dependence of the cross section for the reaction going through the 13.88 MeV level indicates the existence of a broad state in 20Ne with an excitation energy near 24 MeV. Apparently, resonance effects are present in the initial-state interaction at this excitation. Any quasi-elastic scattering appears as a background under the peaks of the sequential reaction. The angular distribution of this background is in limited agreement with the predictions of a modified Born approximation model which takes into account the final state interaction between the two alpha particles. Author (TAB)

N68-30502# Naval Radiological Defense Lab., San Francisco, Calif.

GAMMA-RAY PULSE-HEIGHT SPECTRA: FORMATION OF A RESPONSE MATRIX FOR ITERATIVE UNFOLDING

Daniel Sam, Leland R. Bunney, and Drexel C. Heater 20 Nov. 1967 45 p refs

(USNRDL-TR-68-47; AD-670479)

The gamma-ray spectra of fission products resulting from nuclear weapon detonations provide basic data required in fallout exposure and shielding calculations. One method for obtaining the gamma-ray spectra is the application of the iterative unfolding technique to the measured pulse-height spectra. This technique, however, requires the construction of a response matrix which contains a series of response functions of the detector assembly to various gamma-ray energies. This report describes the essential steps in the construction of a response matrix, having the dimensions 100 energy bins and 1024 channels, used to obtain the complex gamma-ray spectra from the experimental pulse-height spectra. The photons of interest have an energy range extending from 0.060 to 5.00 Mev. The report also presents the associated computer programs for generating and using the response matrix. The results of unfolding of synthesized pulse-height spectra having a known number of gamma rays of known energy are presented. The computer programs are written in Fortran II language for use with an IBM-704 computer. Author (TAB)

N68-30519# Turin Univ. (Italy).

THEORETICAL WORK IN QUANTUM FIELD THEORY AND ELEMENTARY PARTICLES Final Scientific Report

S. Fubini 31 Jan. 1968 13 p refs

(Grant AF-EOAR-66-29)

(AFOSR-68-1131; AD-670179)

The results of two years work in the area of current algebras and superconvergence sum rules are summarized. A bibliography of the 25 papers published as a result of the work is included. TAB

N68-30524# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON THE COEFFICIENT OF SURFACE IONIZATION OF FAST SECONDARY PARTICLES [O KOEFFITSIYENTE POVERKHNOSTNOY IONIZATSII BYSTRYKH VTORICHNYKH CHASTITS]

U. A. Arifov, Kh. Kh. Khadzhimukhamedov, and A. Kh. Ayukhanov 19 Sep. 1967 11 p refs Transl. into ENGLISH from Izv. Akad. Nauk Uz. SSR, Ser. Fiz. Mat. Nauk (Tashkent), no. 1, 1966 p 57–61

(FTD-HT-67-49; AD-670060)

After a brief review of the literature, it is noted that there is no clarity in the question on the charge state of fast particles emitted from a surface and on the application of the law of surface ionization to these particles. Therefore, an experimental study was undertaken on the charge state of surface-emitted fast particles depending on the ionization energy and potential of bombarding ions. It was concluded that the scattering in the form of positive ions depends not on the charge state of the primary particle, but on the ionization potential of the bombarding particle. This process, however, only qualitatively agrees with the mechanisms of surface ionization. This should have been expected, since secondary scattered ions have an entire energy spectrum, from thermal to limiting, determined by single and multiple elastic collisions of the bombarding particle with the atoms of the metal. A better agreement of the results with the surface ionization mechanism may be obtained, apparently, only for the group of slow ions with energies below 10 ev. TAB

N68-30539# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.

ASYMPTOTIC BEHAVIOR OF THE EIGENVALUES OF THE SCHRODINGER OPERATOR

V. P. Maslov 28 Mar. 1968 14 p refs Transl. into ENGLISH from Usp. Mat. Nauk (USSR), v. 20, no. 6(126), 1965 p 134–138

(Contract NOw-62-0604-c)

(TG-230-T547; AD-669934)

The author considers the eigenfunction problem minus epsilon squared Psi double prime sub n + v(x) Psi sub n = lambda sub n Psi sub n, the integral from minus infinity to infinity of (Psi squared sub n dx) = 1. He investigates the asymptotic behavior of the solutions of this problem with respect to the parameters as epsilon approaches zero and n approaches infinity, such that nepsilon approaches a constant, lambda sub n approaches lambda, i.e., the quasi-classical behavior. TAB

N68-30554# Polish Academy of Sciences, Cracow. Inst. of Nuclear Research.

DO WE KNOW HOW TO DISTINGUISH BETWEEN PERIPHERAL AND CENTRAL HIGH-ENERGY MANY-BODY COLLISIONS?

Lech Michejda 1968 29 p refs Presented at a Seminar at the Inst. of Nucl. Res., Cracow

(IBJ-P-889/6/PH) CFSTI: $3.00

The idea of peripheral or central high-energy collisions is expressed in terms of partial inelastic cross sections corresponding to the initial particles being in the angular momentum state. Various attempts to determine the total angular momentum J of the many-body states and hence also of the cross sections via the overlap function are discussed. It is shown that for the 8 GeV/c π^+p interactions neither the uncorrelated jet model nor the multi-Regge-exchange model yield the angular momenta which would satisfy the unitarity condition of the S-matrix, unless the variable phase of the wave function is introduced. From the fact that most of the anisotropy required by the high values of J expected from the data on elastic scattering is hidden in a phase dependence, and from a study of models with variable phase, it is concluded that it is not possible to solve the question of distinguishing between peripheral and central collisions. Author

N68-30567# Navy Dept., Washington, D. C.

ON THE MECHANISM OF ENERGY TRANSFER IN ORGANIC COMPLEXES OF RARE EARTHS [O MEKHANIZME MIGRATSII ENERGII V ORGANICHESKIKH KOMPLEKSAKH REDKIKH ZEMEL]

V. V. Kuznetsova and A. N. Sevchenko 17 May 1968 8 p refs Transl. into ENGLISH from the book "Fizicheskiye Problemy Spektoroskopii, Akademiy Nauk SSSR, Komissiya No Spektroskopii, v. 1" Moscow, Akad. of Sci. 1962 p 236–239

(TRANS-2604; AD-669987)

Emission spectra were obtained of the rare earth ions both for the crystalline and solution states of compounds of europium and samarium with beta-diketones and with derivatives of salicyaldehyde, 2-hydroxynaphthaldehyde, picric acid, phenanthrolin and dipyridyl. The measurements of the duration of luminescence of the various complexes indicate that the process of transfer of energy does not materially increase the lifetime of the excited state of the ions of the rare earths. The difference in the durations of the excited states for the different complexes and salts is no greater than the variation found in going from one simple salt to another, and cannot be explained by the difference in radiationless deactivation within the lanthanide ion. TAB

N68-30583# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).

ELECTROMAGNETIC CORRECTIONS TO KAON–3 PION RATES

A. Neveu and J. Scherk [1968] 7 p refs
(TH-68/17) CFSTI: HC $3.00/MF $0.65 CSCL 20H

A simple model is presented for calculating part of the electromagnetic corrections to $K \rightarrow 3\pi$ rates, and their consequences on the predictions of various selection rules in nonleptonic decays of kaons. Comparison is made with experimental data. Author

N68-30584# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
REGGE BEHAVIOR, KINEMATICAL SINGULARITIES AND FIXED POLES
S. Caser and J. L. Basdevant Jun. 1968 10 p refs
(TH-68/15) CFSTI: HC $3.00/MF $0.65 CSCL 20H

It is shown that the problems of daughter trajectories, conspiracy, evasion, are closely related to the existence of fixed poles in angular momentum. If fixed poles are discarded, then daughters, conspirators or vanishing residues, occur. This is obtained by assuming the scattering amplitude below threshold to be given by a dispersion integral on the Regge behavior above threshold. Author

N68-30621# Polish Academy of Sciences, Cracow.
STUDY OF THE (D,P) REACTION OF Ti^{48} AND Ti^{50} NUCLEI [REAKCJE TYPU (D,P) NAJADRACH Ti^{48} I Ti^{50}]
K. Grotowski, A. Jasielska, T. Panek, F. Pellegrini, and S. Wiktor Mar. 1968 30 p refs
(INP-594/PL) CFSTI: HC $3.00/MF $0.65

Proton spectra from $^{48}Ti(d,p)^{49}Ti$ and $^{50}Ti(d,p)^{51}Ti$ reactions at incident deuteron energy of 12.9 MeV were measured in wide range of angles. Six proton groups leading to: ground, 1.38, 1.72, 2.50, 3.26 and 3.80 MeV states of ^{49}Ti nucleus and two proton groups leading to: ground and 1.16 MeV states of ^{51}Ti nucleus were taken for the analysis of angular distributions. The distorted wave, zero range Born approximation method was applied to the l-values as well as spectroscopic factors corresponding to different transitions were obtained. Four different sets of parameters of the deuteron optical potential were used in the DWBA analysis and their influence on the shape of angular distributions and the magnitude of spectroscopic factors was investigated. These potentials only which have the depth of the real potential not lower than about 100 MeV appeared to be acceptable. In measured angular distributions noticeable effects due to different coupling of spin and orbital angular momentum of transferred neutron were observed. The differences in shapes of angular distributions caused by that effect were related to the polarization of protons scattered elastically on Ti nuclei. Author

N68-30622# Los Alamos Scientific Lab., N. Mex.
EVALUATED NEUTRON CROSS SECTIONS FOR DEUTERIUM
Anthony Horsley (Atomic Weapons Res. Estab., Aldermaston, Engl.) and Leona Stewart Jan. 1968 139 p refs Prepared jointly with the Atomic Weapons Res. Estab., Aldermaston, Engl.
(Contract W-7405-ENG-36)
(LA-3271) CFSTI: HC $3.00/MF $0.65

A compilation of evaluated data on the neutron cross sections of deuterium is presented for incident neutron energies of 0.0001 eV to 20 MeV. The data are displayed in graphical and tabular form. Legendre coefficients are included for the scattering angular distributions. Proton spectra from neutron and proton reactions with deuterium are also included, as are proton production cross sections and neutron production cross sections. NSA

N68-30637# Michigan Univ., Ann Arbor. Inst. of Science and Technology.
MEASUREMENT OF THE TIME VARYING COMPONENT OF RADIATION FROM INFRARED SOURCES
E. C. Hall, M. L. Fecteau, and C. L. Roe May 1968 51 p refs
(Contract ARPA SD-91)
(Rept.-4613-105-T; AD-669833)

Techniques for the calibration of a temporal radiometer were studied. The calibration described for either periodic or random fluctuations utilizes sinusoidally modulated radiation from a blackbody. A complete description is given of the data acquisition and analysis facilities which were assembled for this study and used to calibrate a test radiometer. The practical aspects of spectral analysis (including the interplay among filter bandwidth, scan rate, data sample length, and averaging time) are discussed, and a technique for measuring the noise equivalent bandwidth of the frequency-selective filter in the spectrum analyzer is described. Author (TAB)

N68-30649# Ecole Polytechnique, Paris (France). Centre de Physique Theorique.
THE DECAY SPECTRUM OF POLARIZED MUONS IN THE GENERAL FERMI INTERACTION
Viorica Florescu and Osamu Kamei Feb. 1968 19 p refs
(NP-17451; A112.268)

A general expression for the decay spectrum of the polarized muon is obtained assuming the general Fermi interaction with radiative corrections. This permits discussion of the decay spectrum with 1% accuracy. New parameters ϕ and κ are introduced to display the deviation from the V,A interaction. The measurement of these parameters is not much more difficult than that of the usual low energy parameter η, but is cutoff dependent. Author (NSA)

N68-30689# Los Alamos Scientific Lab., N. Mex.
SYMMETRIC FISSION OF A TWO-PARAMETER LIQUID DROP
James N. P. Lawrence (Ph.D. Thesis—Vanderbilt Univ.) 4 Oct. 1967 140 p refs
(Contract W-7405-ENG-36)
(LA-3774) CFSTI: HC $3.00/MF $0.65

A review of fission theory is presented with attention focused on the liquid drop model. The contour of the liquid drop is described by a two-parameter equation in order that dynamic calculations could be performed. To obtain an indication of the accuracy to be expected in the dynamics, calculations of the fission-barrier energy and other saddle-point properties were made and compared with other studies. The equations of motion were derived under the assumptions of incompressibility and irrotational fluid flow. With the time-dependent coordinates being the two shape parameters, a velocity potential is defined as a sum of terms, each of which satisfies Laplace's equation. The coefficients of each term are fixed by the boundary conditions and are seen to be functions of the shape parameters and their first derivatives. Lagrangian mechanics furnish the basis for the equations of motion. Tests of the theory are proposed and evaluated numerically using a two-term "velocity potential." Author (NSA)

N68-30695# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).
SEPARATION OF INFRARED CONTRIBUTIONS TO RADIATIVE CORRECTIONS IN TERMS OF AN EXPONENTIAL FACTOR UNDER GENERAL EXPERIMENTAL CONDITIONS
R. D. Kohaupt Mar. 1968 20 p refs
(DESY-68/16)

It is shown that the usual splitting of infrared contributions to radiative corrections in terms of an exponential factor cannot be valid under general kinematical conditions. A modified formula is derived which avoids the shortcomings of the original formulation. The approximations made in this context are discussed in detail. Author (NSA)

N68-30696# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).

NON-FORWARD PHOTOPRODUCTION OF ρ^0 MESONS FROM COMPLEX NUCLEI

J. Fleischer Mar. 1968 11 p refs

(DESY-68/15)

The nonforward coherent photoproduction of ρ^0 mesons was calculated following closely the model of Drell and Trefil, and Ross and Stodolsky. Inside the nucleus the ρ^0 wave functions shall satisfy the Klein–Gordon equation with a purely imaginary potential. From the wave function at the nuclear surface the production amplitude is constructed by the Kirchhoff method known from classical optics. In a recent experiment indications of diffraction minima and maxima were observed, the general features of which seem to be well reproduced by this calculation. Author (NSA)

N68-30697# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).

QUASIELASTIC ELECTRON-DEUTERON SCATTERING BETWEEN $q^2 = 18\,f^{-2}$ AND $100\,f^{-2}$

W. Albrecht, H.-J. Behrend, H. Dorner, W. Flauger, and H. Hultschig Mar. 1968 11 p refs

(DESY-68/14)

Quasi-elastic e-d scattering measurements were performed up to $q^2 = 100\ f^{-2}$. Only the electron was detected. The ratio $R = (d^2\sigma/d\Omega dE')_{ed}/(d\sigma/d\Omega)_{ep}$ was measured at the quasi-elastic peak; the magnetic form factor G_M^N of the neutron was deduced using the assumption $G_E^N = 0$. Author (NSA)

N68-30699# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).

VECTOR MESON DOMINANCE ANALYSIS OF DATA ON THE REACTION $\pi^- + p \rightarrow \rho^0 + n$

Margarete Krammer Feb. 1968 7 p refs

(DESY-68/6)

The data on the reactions $\gamma p \rightarrow \pi^+ n$ and $\pi^- p \rightarrow \rho^0 n$ are compared. The V.D.M. relation is found to be satisfied at small momentum transfers. There are discrepancies for higher $|t|$ and at the maximum energy investigated. Author (NSA)

N68-30700# Hamburg Univ. (West Germany). Institut fuer Theoretische Physik (2).

A CALCULATION OF THE ELASTIC N–N PHASE SHIFTS USING STRONG COUPLING FIELD MESON THEORY

Siegfried Wagner Deut. Elektronen-Synchrotron Feb. 1968 19 p refs

(DESY-68/9)

Wentzel's strong-coupling solutions of the fixed-source meson field theory derive the nucleon isobars in pion–nucleon interaction. The isobars are also relevant as intermediate states in nucleon–nucleon interaction. If only the lowest ones are included, the multichannel Schrödinger equation can be solved exactly, using Fierz's matrix representation of the strong-coupling solutions. In addition a core potential of Wigner type can be derived for small separations of the sources; this potential is idealized as a hard core of about .55 fermis. Contrary to previous calculations of A. Houriet et al., all N_{33}^* intermediate states are included. Good agreement is obtained for the S-wave phase shifts. All other phase shifts are in qualitative agreement with experiments, except for triplet P. At high energies deviations were established, which indicate that a short range spin–orbit potential is missing. Author (NSA)

N68-30702# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

PACIFIC NORTHWEST LABORATORY DIVISION OF ISOTOPE DEVELOPMENT PROGRAMS Quarterly Report, Jul.–Sep. 1967

R. L. Moore ed. Jan. 1968 22 p refs

(Contract AT(45-1)-1830)

(BNWL-681) CFSTI: HC $3.00/MF $0.65

Progress is reported on the development of promethium isotopic fuels and other radioisotope research programs. Fabrication of the 60 W Advanced Manned Strategic Aircraft (AMSA) heat source was successfully completed. Final impact testing of Phase II AMSA simulated heat source capsules was completed. Cold pressing and sintering of the Pm_2O_3 pellet for the AMSA capsule were carried ot in a lead-shielded glovebox modified with an extension which fitted between the platens of a 200 ton press. Fabrication of the inner tantalum capsule and the outer L-605 alloy capsule was accomplished using electron beam welding. The dose rate of the encapsulated heat source was measured at 12 in. from its center. The AMSA capsule was measured for thermal output for a 48 hr period. The power output of the capsule was 60.32 ± 0.07 W at 95% confidence level. NSA

N68-30705# United Kingdom Atomic Energy Authority, Harwell (England). Solid State Physics Div.

THE MOLECULAR DYNAMICS OF METHANE IN ARGON

O. J. Eder (Phys. Inst., Seibersdorf, Austria) and P. A. Egelstaff Seibersdorf, Austria Osterreichische Studiengesellschaft fur Atomenergie G.m.b.H. [1967] 18 p refs

(SGAE-PH-65/1968) CFSTI: HC $3.00/MF $0.65

The inelastic and quasielastic scattering of 5.3 A neutrons has been studied for the system Methane in Argon at 86°K. The experimental data have been taken for two concentrations (1.6 and 3.2 molar %), and six scattering angles. A discussion of the changes in the scattering pattern as compared to scattering experiments on pure methane performed under comparable conditions is presented. Using a new approach for the rotational motion of the methane molecules a comparison with our experimental data is made, assuming the methane molecules to rotate nearly freely at short times and undergo rotational diffusion at long times, while discussing the center of mass motion in terms of a modified "itinerant oscillator model". The data are consistent with the view that the argon atoms form a "cage" around the methane molecules in which the rotation is continuously but weakly hindered and where the long time translational motion can be described by simple diffusion, while for the short time behaviour some new approach is needed. Author

N68-30721# Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires.

RADIATIVE DETECTION OF THE NUCLEAR MAGNETIC RESONANCE OF EXCITED NUCLEAR STATES [DETECTION RADIATIVE DE LA RMN D'ETATES NUCLEAIRES EXCITES]

Maxime Nechtschein Mar. 1968 27 p refs In FRENCH

(CEA-BIB-107)

Methods are described for observing the magnetic resonance between sublevels of excited nuclear states. The nuclear magnetic resonance is detected by the change which it produces in the angular distribution of the radiation emitted by the radioactive nuclei. The case of a statistic nuclear orientation, obtained either by apply a strong magnetic field at very low temperature or as the result of a nuclear reaction, and the case of the perturbed angular correlation are considered. Author (NSA)

N68-30730* Aztec School of Languages, Inc., Actont, Mass.

CERTAIN SPECIFIC FEATURES OF OVERLAPPING SPECTRAL LINE BROADENING [O NEKOTORYKH SPETSEFICHESKIKH OSOBENNOSTYAKH USHIRENIYA PEREKRYVAYUSHCHIKHSYA SPEKTRALNYKH LINIY]

V. A. Alekseyev and I. I. Sobel'man Washington NASA Jul. 1968 18 p refs Transl. into ENGLISH from the Russian Presented at the Quantum Electron. Conf., Miami, 14–17 May 1968

(Contract NASw-1692)

(NASA-TT-F-11817) CFSTI: $3.00 CSCL 07D

A general theory is discussed for impact broadening on the assumption that all necessary conditions have been satisfied for using such an approximation. Several simple examples are given concerning the effect of narrowing, and consideration is given to Raman scattering in gases as pertains to the Q-branch substructure. Formulas and schematics are given for clarification. Author

N68-30748# California Univ., Livermore. Lawrence Radiation Lab.
THE ONE-PARTICLE DENSITY MATRIX FOR HARD-SPHERE BOSONS AT ZERO TEMPERATURE
J. C. Garrison and J. Wong 17 Jan. 1968 49 p refs
(Contract W-7405-ENG-48)
(UCRL-50377) CFSTI: HC $3.00/MF $0.65

A calculation, using the binary kernel expansion developed by Lee and Yang, of the one-particle density matrix for a system of hard-sphere bosons at zero temperature is presented. The Fourier transform of the density matrix exhibits a delta function behavior at zero momentum; the coefficient is evaluated as an expansion up to first order in the small parameter $(\rho a^3)^{1/2}$, where ρ is the density and a is the hard sphere radius. The form of the Fourier transform for nonzero values of the momentum is also obtained. From these results the fraction of particles in the condensed (zero-momentum) mode is calculated. The results are in agreement with those of Lee, Huang, and Yang obtained by using the pseudo-potential method. Author (NSA)

N68-30767# Nihon Univ., Tokyo (Japan). Dept. of Physics.
EXTENDED PARTICLE MODEL OF ELEMENTARY PARTICLES
Osamu Hara and Tetsuo Goto [1967] 127 p refs
(NUP-A-68-8) CFSTI: HC $3.00/MF $0.65

A unified model for hadrons and other elementary particles is presented based on the assumption that such particles have some spatial extension, and the internal levels of motion carried by this extension are considered. If the structure is rigid, this motion is the rotation around the center of mass; and the internal state is specified by three quantum numbers: (1) J is the magnitude of angular momentum, (2) K is the component along the third axis and identified with twice the baryon number, and (3) M is the spin component. For such a model, which can be satisfied by an equivalent of the generalized Dirac equation, the mirror image of the particle is its antiparticle. The nonconservation of parity or the existence of SU_3 and SU_6 internal symmetries appear as rather general features of the extended particles that are not necessarily dependent upon their specific forms. M.W.R.

N68-30775# Polish Academy of Sciences, Warsaw.
MEASUREMENTS OF PROTON SPIN-LATTICE RELAXATION TIME IN ORDINARY AND PARTIALLY DEUTERISED LIQUID SILANE [POMIARY CZASU RELAKSACJI SPINOWO-SIECIOWEJ PROTONOW W ZWYKLYM I CZESCIOWO DEUTERYZOWANYM CIEKLYM SILANIE]
M. Bozek, J. W. Hennel, A. Jasinski, and S. Kozinski Jan. 1968 8 p refs
(INP-583/PL) CFSTI: HC $3.00/MF $0.65

Measurements of the proton spin-lattice relaxation time T_1 in liquid silane and in partially deuterated liquid silane are reported. The obtained temperature dependence of T_1 may be explained by dipolar and spin-rotational interactions. Author

N68-30780# Polish Academy of Sciences, Warsaw.
SOME EXPERIENCES IN THE USE OF SEMICONDUCTOR DETECTORS FOR FISSION STUDIES IN THE HIGH-ENERGY PROTON BEAM AT CERN [WSTEPNE WYNIKI ZASTOSOWANIA DETEKTOROW POLPRZEWODNIKOWYCH DO BADANIA ROZSZCZEPIENIA WYWOLANEGO PROTONAMI WIELKIEJ ENERGII Z AKCELERATORA W CERNIE]
R. Brandt, T. Krogulski, E. Piasecki, H. Piekarz, M. Sowinski et al 1968 24 p refs
(P-885/IA, 2/PH) CFSTI: $3.00

Two test experiments are described in which the semi-conductor technique has been applied to fission studies in a high-energy proton beam at the proton synchrotron. The technical details of an experimental procedure are described. Some preliminary results on fission in uranium induced by 14 GeV protons are given. Author

N68-30781# Polish Academy of Sciences, Warsaw.
CLASSICAL APPROACH TO QUANTUM AND WAVE PHENOMENA [KLASYCZNE PODEJSCIE DO PROBLEMU KWANTOWANIA I ZJAWISK FALOWYCH]
Michal Gryzinski 1968 8 p refs In POLISH; ENGLISH summary
Presented at Intern. Conf. on Nucl. Phys., New York, 3–7 Jun. 1968
(P-908/XVIII/PP) CFSTI: HC $3.00/MF $0.65

The paper shows that the inherent dependence between the translational motion of the electron and the motion of its spin axis—which results in appearance of the alternating component of the electric field, is the cause of "wave" phenomena and quantization of energy. Author

N68-30782# Institute of Nuclear Research, Krakow (Poland).
SOME METHODS AND RESULTS OF THE INVESTIGATION OF SPIN WAVES [NIEKTORE METODY I WYNIKI BADAN FAL SPINOWYCH]
Adam Wanic 1968 36 p refs In POLISH; ENGLISH summary
(INP-598/PS) CFSTI: $3.00

The neutron, spectroscopic, and microwave methods of the investigation of spin waves are described. The results of the neutron measurements of the magnon dispersion relations in a number of magnetics are reviewed. Author

N68-30790# Southampton Univ. (England). Dept. of Aeronautics and Astronautics.
APPLICATION OF HALEVI'S CORRECTION TO THE EINSTEIN COEFFICIENTS OF THE N_2 FIRST POSITIVE SYSTEM (N_2 1 PG)
R. E. W. Jansson and B. E. Cunio [1967] 21 p refs
(AASU-279) CFSTI: HC $3.00/MF $0.65

The second order correction to the diatomic band strength was computed for an array of N_2 first positive bands using Morse functions to represent the potentials of the upper and lower states. Contrary to previous beliefs, these are shown to be good approximations to R.K.R. potentials up to $v \simeq 12$, giving Franck–Condon factors which agree well with R.K.R. values except when the overlap is very small (at which point the method of computation is inaccurate). The size of Halevi's correction (0 to >20%) is erratic, but there is a qualitative inverse relation between it and the magnitude of the overlap of the wave functions. The correction to the band strength of the 0,0 transition is not an unambiguous guide to the accuracy of a Deslandres table. Using new data, and newly derived r-centroids, Einstein coefficients for the array were calculated, with and without the inclusion of Halevi's correction. An improved method for calculating Einstein coefficients is outlined. Author

N68-30797# Virginia Univ., Charlottesville. Electrical Engineering Div.
DETERMINATION OF THE DEGREE OF IONIZATION OF GAS ATOMS AS A FUNCTION OF X-RAY ENERGY Final Technical Report

W. D. Whitehead, Jr. and Hugh S. Landes May 1968 21 p refs
(Grant AF-AFOSR-110-66)
(EE-3428-101-68U; AFOSR-68-0876; AD-669851)

Photo-ionization of gases may result in many ions with high charge states if the initial event is the removal of an inner shell electron. This may be followed by radiationless or Auger transitions with the result that a number of electrons are removed from the atom. The relative abundances of the various charge states for Krypton and Xenon were measured as a function of maximum x-ray energy. Measurements were made with a radio frequency quadropole spectrometer and a time of flight spectrometer. A crystal diffraction spectrometer was used to analyze the incident x-ray radiation. The average charge for Krypton ions was found to increase +2.8 at 3 Kev to +4.5 at 20 Kev. The optical spectra of singly ionized nitrogen atoms were obtained by means of a 1 Mev Van de Graaff accelerator beam which was excited during its passage through thin foils. Author (TAB)

N68-30798# Naval Research Lab., Washington, D. C.
BIBLIOGRAPHY OF PHOTO- AND ELECTRONUCLEAR DISINTEGRATIONS
M. Elaine Toms, comp. Jul. 1967 213 p Revision Supersedes NRL-BIBL-24
(NRL-BIBL-31; NRL-BIBL-24; AD-669999; AD-471667)

The Bibliography consists of references for theoretical and experimental results published in standard periodicals and proceedings of conferences. Truly inverse reactions have been included as have been studies of photon absorption by nuclei and of their excitation by photons or electrons whenever the reactions are equivalent to the initial part of photo- or electronuclear disintegrations. Results concerning bremsstrahlung spectra and other photon sources have been included. The scope of this bibliography excludes photomeson production, photon-induced radioactivity used to study the resulting nuclei, and photon- or electron-induced excitation of low-lying levels. The compilation consists of 1914 references, through 1966, by 1588 contributing authors. TAB

N68-30803# Hamburg Univ. (West Germany).
FORMULATION OF A RELATIVISTIC QUARK-FIELD THEORY [FORMULIERUNG EINER RELATIVISTISCHEN QUARK-FELDTHEORIE]
Timm Gudehus Hamburg, W. Germany Deutsches Elektronen-Synchrotron Feb. 1968 66 p refs In GERMAN; ENGLISH summary
(DESY-68/11)

Based on a set of appropriately modified Wightman axioms, a relativistic quark-field theory is formulated. The Haag–Ruelle construction of asymptotic states in the form given by Hepp is used to construct the asymptotic states of the phenomenologically known particles with the help of the basic quark fields. General reduction formulas for the reduction of the S-matrix elements to the expectation values of time ordered products of the quark field are given. Some useful concepts are introduced, such as phenomenological fields, general currents, and the Bethe–Salpeter amplitudes of some phenomenological particles. A decomposition into covariants as well as a spectral representation for the Bethe–Salpeter amplitudes of the mesons is derived from the axioms. For the expectation value of a general current between meson or baryon states, an expression due to Mandelstam is generalized. These expressions for the current expectation values contain the Bethe–Salpeter amplitudes of the phenomenological particles. A fundamental ansatz for the Bethe–Salpeter amplitudes of the pseudoscalar mesons, the vector mesons, the 1/2+-baryons, and the 3/2+-baryon resonances is made which implicitly contains the principles of the nonrelativistic quark model. Author (NSA)

N68-30806# Bettis Atomic Power Lab., Pittsburgh, Pa.
TWIGL: A PROGRAM TO SOLVE THE TWO-DIMENSIONAL, TWO-GROUP, SPACE-TIME NEUTRON DIFFUSION EQUATIONS WITH TEMPERATURE FEEDBACK
J. B. Yasinsky, M. Natelson, and L. A. Hageman Feb. 1968 56 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-TM-743) CFSTI: HC $3.00/MF $0.65

The computer program TWIGL, a two-dimensional, two-group, space-time diffusion theory program for rectangular or cylindrical geometries, is described. From zero to six groups of delayed neutron precursors may be used. Temperature feedback effects are accounted for via a one-pass, no-boiling thermal-hydraulic model. The relevant differential equations are represented by space-time difference equations which are solved at each time step by an accelerated iterative procedure. The governing equations, solution technique, and input information are described. Author (NSA)

N68-30808# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
AN APPLICATION OF THE SATZ SUM RULES TO THE HIGH MULTIPLICITY PROCESSES
T. Hofmokl (Warsaw Univ.) and M. Szeptycka 1968 8 p refs Submitted for publication
(INR-P-881/VI/PH)

The relation which follows from the Satz additive quark model between cross sections for the reaction $\pi p \to N(k+1)\pi$ and $pp \to NN\, k\pi$ is found to be in agreement with experimental data for $k=4$ and $k=5$. Author (NSA)

N68-30809# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
ANGULAR CORRELATION BETWEEN NEUTRAL PION MESONS PRODUCED IN NEGATIVE PION Xe INTERACTIONS AT 9 GeV/c NEGATIVE PION INCOMING MOMENTUM
Kinga Eskreys 1968 10 p refs
(INR-P-882/VI/PH)

A strong angular correlation between neutral pions was found in the 9-GeV/c π^--Xe interactions observed in the xenon bubble chamber. The same kind of angular correlations were previously reported for charged pions produced in π-p and π^+-p interactions. Author (NSA)

N68-30812# American Meteorological Society, Boston, Mass.
THE MULTICONFIGURATION APPROXIMATION FOR ATOMIC SPECIES OF HELIUM TYPE [MNOGOKONFIGURATSIONNOE PRIBLIZHENIE V SLUCHAE ATOMOV TIPA GELIYA]
Ya. I. Vizbaraite, V. I. Kavetskis, and A. P. Yutsis Apr. 1965 8 p refs Transl. into ENGLISH from Opt. i Spektroskopiya (Moscow), v. 1, no. 3, 1956 p 282–284
(Contract AF 19(628)-3880)
(T-R-472; AD-669178)

The multiconfiguration approximation is applied to the ground configuration of atomic species of helium type from H(-) to C(4+) by a method in which the results of the self-consistent field are used for the ground configuration, while the corrections to the energy for the multiconfiguration approximation are determined with hydrogen-like analytic wave functions. The resulting values of the total energy are compared with the results of application of the method of partial separation of variables and with the experimental data. Author (TAB)

N68-30821# Polish Academy of Sciences, Cracow.
MOLECULAR DYNAMICS STUDIES BY NEUTRON INELASTIC SCATTERING AND COMPETING METHODS [BADANIE DYNAMIKI MOLEKULARNEJ PRZY POMOCY NIESPREZYSTEGO ROZPRASZANIA NEUTRONOW I METOD KONKURUJACYCH]
Jerzy A. Janik 1968 54 p refs
(INP-600/PS) CFSTI: HC $3.00/MF $0.65

In discussing molecular dynamics two points are stressed: (1) understanding of the process of neutron scattering by molecules of a gas or by what will be called molecular groups in solids and liquids, and (2) obtaining information concerning molecular motions from inelastic neutron scattering experiments and comparing them with those obtained from other techniques. Molecular groups in solids and liquids are either radicals and/or ions such as NH_4^+, H_3O^+ etc. or whole molecules (e.g., CH_4, CH_3I). A selection of existing materials is listed, and a reference bibliography is included. Author

N68-30824*# Hughes Research Labs., Malibu, Calif.
MEASUREMENT OF THE CHARGE EXCHANGE CROSS SECTION OF MERCURY Final Report
David Zuccaro Apr. 1968 52 p refs
(Contract NAS3-7932)
(NASA-CR-72398) CFSTI: HC $3.00/MF $0.65 CSCL 07D

A program directed toward the experimental determination of the resonant charge exchange cross section of thermal velocity mercury atoms and singly charged mercury ions in the energy range 10^2 to 10^4 eV is reported. The experiment envolved the use of an electron bombardment gas discharge ion source and a temperature controlled vapor source. The cesium ion and atom charge transfer cross section was also determined in the same apparatus as a verification of the mercury case. The charge transfer ion currents were measured as functions of the ion beam energy, the gas density in the transfer region, the path length of the transfer region, and various ion source operating parameters. The mercury data fit a theoretical relationship $\sigma^{1/2} \times 10^8 = A - B \log V$ where σ is the cross section in cm^2 and V the ion energy in eV. A least squares fit of 1023 data points gave values of A = 8.623 and B = 0.6354. Values obtained were significantly smaller than the values which have been used previously in the prediction of electrode erosion rates. A small number of measurements of cesium charge exchange cross section were made to correlate this study to the previous cesium studies. Approximately 100 data points were measured. The values obtained were slightly greater than those of Perel, *et al.*, and were clustered about Marino's values. The importance of results to the development of ion thrusters is discussed. S.C.W.

N68-30839# National Research Council of Canada, Ottawa (Ontario).
NUMERICAL SOLUTION OF THE THOMAS-FERMI EQUATIONS FOR POSITIVE VALENCE DIFFERENCES
R. F. Henry Dec. 1967 29 p refs
(DME-MK-21; NRC-1001; AD-669928)

Analytical problems in the solution of the Thomas-Fermi equation are discussed and an iterative numerical method of solution is presented, together with suitable computer programs for its implementation. Author (TAB)

N68-30842# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics.
SCATTERING OF LIGHT BY AN ELECTRON MOVING IN A REFLECTIVE MEDIUM
I. M. Frank 1968 13 p Presented to the Phys. Soc. of Japan, 14 Sep 1967
(JINR-E4-3760)

The scattering of light by an electron moving in a refractive medium is considered. It is shown that besides the normal scattering, when the incident photon is converted into the photon of the scattered light, another mechanism of scattering is possible—when the incident photon is not absorbed but gives rise to the photon of stimulated radiation and, in addition, the photon of the scattered light appears. The ratios are obtained, which connect the frequency of the initial light with that of the scattered light for both cases, i.e., for the normal and anomalous scattering. The condition is given for the frequencies of the two-photon Vavilov–Cherenkov effect. Author (NSA)

N68-30851# Atomic Energy Board, Pretoria (South Africa).
ABSOLUTE STANDARDISATION OF PURE BETA-EMITTERS BY THE EFFICIENCY TRACING TECHNIQUE
M. C. B. Smit Sep. 1967 11 p refs
(PEL-162)

A new method to standardize pure β-emitting nuclides using a modified efficiency tracing technique was developed. By using external absorbers to decrease the counting efficiency, inaccuracies due to differential self-absorption are eliminated and a suitable tracer can be selected irrespective of its chemical compatibility with the β emitter. A theory is developed in which the absorption corrections are made by the use of the efficiency ratio for the particular nuclide pair. Author (NSA)

N68-30862# Hamburg Univ. (West Germany).
USE OF STATISTICAL MODELS WITH ANGULAR MOMENTUM CONSERVATION [ZUR ANWENDUNG DES STATISTISCHEN MODELLS MIT DREHIMPULSERHALTUNG]
Gunter Van Keuk Hamburg, W. Germany Deutsches Elektronen-Synchrotron Feb. 1968 99 p refs In GERMAN; ENGLISH summary
(DESY-68/10)

A statistical model with energy-momentum and angular-momentum conservation is described and discussed taking into account different masses, spins and isospins of the outgoing particles. The phase-spaces are evaluated approximately by the use of asymptotic expansions for large particle numbers. The probability of fireball formation is assumed to vanish at high energy for each partial wave as a consequence of the Lorentz contraction of the interaction volume. Describing fireball formation and decay separately, cross sections are derived for all central events. Including statistical p-production our numerical results are, in nearly all cases, in good agreement with the experimental data on $p\bar{p}$-annihilation into pions from 1.6 to 7.0 GeV/c. Author (NSA)

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N68-29595# Princeton Univ., N. J. Dept. of Astrophysical Sciences.
ON THE KINETIC THEORY OF STABLE AND WEAKLY UNSTABLE PLASMA
Andre L. Rogister (Ph.D. Thesis) Nov. 1967 112 p refs Submitted for publication Sponsored jointly with ESRO and NAS-NRC
CFSTI: HC $3.00/MF $0.65

Within the framework of the Klimontovich formalism, a kinetic theory of spatially homogeneous plasma in which discreteness effects and collective behavior are treated on a par is presented. The theory is thus no longer Markoffian in the one-particle distribution

functions $F^{(1)}$ alone, but is in the pair $|F^{(1)}, I_k|$ (with I_k the fluctuation spectrum of the waves). The kinetic description then embraces not only the Bogoliubov regime, where the Balescu–Lenard equation is recovered and the weakly unstable situation, where the results of quasilinear theories is also recovered. It is the first systematic theory which applies to those regimes which are dominated by collisional absorption of the waves and/or emission by wave-particle and particle-particle scattering (bremsstrahlung). With the introduction of original contour deformations, the equations also provide the continuous transition from instability to stability, so that an initially weakly unstable plasma can be followed to thermal equilibrium. Author (ESRO)

N68-29596# Comitato Nazionale Per l'Energia Nucleare, Frascati (Italy). Laboratori Gas Ionizzati.

SOME PROPERTIES OF THE PLASMAS PRODUCED BY IRRADIATING LIGHT SOLIDS BY LASERS

A. Caruso and R. Gratton Jan. 1968 22 p refs Sponsored in part by EURATOM

(LGI-68-2) CFSTI: HC $3.00/MF $0.65

A theory is proposed for the process of irradiation of finite solid targets of light atoms (H_2, D_2, Li) by giant laser pulses. The properties of the produced plasma are studied and the conditions to be satisfied in order to obtain an isotropic plasma are given. Author (ESRO)

N68-29604 Wisconsin Univ., Madison.

AN EXPERIMENTAL STUDY OF ION ENERGY DISTRIBUTION FUNCTIONS IN A TOROIDAL OCTUPOLE MAGNETIC FIELD

Clifford Wayne Erickson (Ph.D. Thesis) 1967 134 p

Available from Univ. Microfilms: HC $6.40/MF $3.00 Order No. 67-8994

A new device for the extraction of ions from the main body of a confined plasma is reported. The device is a tube of ferromagnetic shielding material which provides a field-free path from the plasma to the exterior of the confining octupole field. Ions traverse the path and enter an external electrostatic energy analyzer. In an alternate version of the device the energy analysis is done by a miniature analyzer inserted into the tip of the tube. This permits the measurement of all ions whose directions lie in the plane perpendicular to the tube. A theory of the device is given, along with an experimental verification of the theory. The number of ions traversing the tube is a strong function of the potential drop between the plasma and the tube. This is a manifestation of the refraction which occurs as a charged particle crosses an interface separating two regions of different electrostatic potential. Dissert. Abstr.

N68-29629 Case Inst. of Tech., Cleveland, Ohio.

THEORETICAL AND EXPERIMENTAL STUDY OF A SURFACE WAVE ON A TEMPERATURE COLLISIONAL PLASMA COLUMN

Nicholas John Kolettis (Ph.D. Thesis) 1966 139 p

Available from Univ. Microfilms: HC $6.60/MF $3.00 Order No. 67-11554

The axisymmetric transverse magnetic surface wave mode, excited by a magnetic current source and propagated on a uniform temperate plasma column with collisions, is analyzed. Numerical solutions of the determinantal equation for the sourceless problem are presented in the form of βa vs. f and αa vs. f dispersion curves, with β and α the propagation and attenuation factors of the mode, respectively, a the column radius and f the applied frequency. A most prominent characteristic of these solutions is the strong dependence of α upon ν, the effective collision frequency for momentum transfer between electrons and neutrals. Temperature effects play a secondary overall role. The theory has been implemented by an experiment performed on a low pressure DC Argon discharge in a thin walled glass tube, coupled with a Fabry–Perot type resonator of adjustable length. This data was then used in conjunction with the theory as a diagnostic tool, to estimate an average electron density and an effective collision frequency in the discharge, at a given pressure and current. Dissert. Abstr.

N68-29685 Stanford Univ., Calif.

ELECTROSTATIC PROBE THEORY AND APPLICATION IN A HIGH-TEMPERATURE, COLLISION-DOMINATED, POTASSIUM-SEEDED ARGON PLASMA

Harris Bonar Mc Kee (Ph.D. Thesis) 1967 189 p

Available from Univ. Microfilms: HC $8.60/MF $3.00 Order No. 67-11051

An analytic examination of the effect of volume ionization and recombination in the vicinity of an electrostatic probe and an experimental investigation using a large cylindrical probe in a high pressure plasma is reported. Previous studies of electrostatic probes have not considered the effects of volume ionization and recombination when the characteristic length for ionization is of the order of the probe size. Because the probe acts as a sink for charged particles, the electron number density near the probe will be depressed compared to its equilibrium value, even when the temperature is uniform. Since the ionization rate will exceed the recombination rate near the probe, there will be a tendency for the degree of ionization to be augmented. The effect of this mechanism is to decrease the spatial extent of the perturbation of the density and potential profiles by the probe and to increase the current collected at a given biasing voltage. Calculations indicate that such ionization may be important in a typical system near atmospheric pressure involving potassium seed in argon for temperatures above about 1700°K. Dissert. Abstr.

N68-29687 Stanford Univ., Calif.

ELECTRON DISTRIBUTION FUNCTION IN A NONEQUIPARTITION PLASMA

John Robert Viegas (Ph.D. Thesis) 1967 103 p

Available from Univ. Microfilms: HC $5.20/MF $3.00 Order No. 67-11077

Solutions to the kinetic equation of a steady, homogeneous plasma of arbitrary degree of ionization subjected to strong electric fields are developed. Nonelastic as well as elastic encounters are included in the analysis. Expressions for the current density, electrical conductivity and electron temperature of the plasma are also presented. Calculations are presented showing the transition of the isotropic part f^0 of the distribution function from a gas-temperature Maxwellian at near equilibrium conditions to an electron-temperature Maxwellian under nonequipartition conditions. It was found that whenever the electron-electron to electron-neutral collision-frequency ratio was much greater than the electron-to-heavy-particle mass ratio, f^0 is Maxwellian. When f^0 is Maxwellian, the Chapman–Enskog and Spitzer–Härm conductivity expressions developed for the case of weak electric fields are shown to be applicable for strong electric fields providing that in these expressions the electron temperature replaces the gas temperature. Dissert. Abstr.

N68-29714# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Gas Ionizzati.

USE OF EXPLODING FOILS IN A RAPID THETA-PINCH

J. C. Linhart and G. Schenk Dec. 1967 25 p refs Sponsored in part by EURATOM

(LGI-67-25) CFSTI: HC $3.00/MF $0.65

In most theta-pinches aiming to produce energetic plasma the conversion efficiency of the energy condenser bank into that of the plasma is about 1%. This is due mainly to the slow rise-time of the B_z magnetic field. The transfer of bank energy into kinetic energy of the collapsing plasma can be improved, B_z rising to its maximum in a time much shorter than the collapse time.

To approach this situation a switching device using an exploding foil as an element of the bank-theta-coil circuit is described and discussed. Author (ESRO)

N68-29812# Vanderbilt Univ., Nashville, Tenn. Dept. of Physics.
PLASMA FRONT STUDIES Final Scientific Report, 1 Mar. 1966–29 Feb. 1968
John Paul Barach 8 Mar. 1968 8 p refs
(Grant AF-AFOSR-287-66)
(AFOSR-68-1034; AD-669572)

A summary is given of work done in 1966-1967 on behavior of electric shock tube plasmas. Mention is made of magnetic interaction experiments (flux transport and induction generator), arc spectroscopy, and shock flow experiments at both high and low density. Throughout, the importance of ejected driver material is emphasized; the flow is basically blast wave in character. Author (TAB)

N68-29888*# Humphreys Corp., Concord, N. H.
INDUCTION PLASMA HEATING: SYSTEM PERFORMANCE, HYDROGEN OPERATION AND GAS CORE REACTOR SIMULATOR DEVELOPMENT
Merle L. Thorpe Washington NASA Aug. 1968 47 p refs
(NASA-CR-1143) CFSTI: HC $3.00/MF $0.65 CSCL 20I

The induction plasma heating system has been studied and optimized. A reliable 80 kW 3 in. diameter sheath system has been developed which permits efficiently heating argon core gas to arc temperatures surrounded by a high velocity sheath of hydrogen. This unit will permit studies of mixing, fuel addition and other related phenomena associated with such a heat addition system. Other studies of hydrogen heating and particle injection into the arc are described. Author

N68-29902*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ONSET AND SUPPRESSION OF PLASMA INSTABILITY IN CROSSED-FIELD GEOMETRY
B. D. Sidney, R. V. Hess, and F. Allario [1968] 18 p refs Presented at the Southwest Meeting of the Am. Phys. Soc., Los Alamos, N. Mex., 17–19 Jun. 1968
(NASA-TM-X-61021) CFSTI: HC $3.00/MF $0.65 CSCL 20I

A linear Hall accelerator with axial and azimuthal probe wires was prepared to investigate the relation between low frequency azimuthal rotating plasma instability onset and a critical magnetic field in a crossed-field geometry. Measurements were made of the floating potential and ion saturation current in argon, xenon, helium, and nitrogen with an arc current of 2.5 amperes and using a spectrum analyzer or dual-beam oscilloscope. Effects resulting from the magnetic field generated by the cathode current and configuration showed that the instability onset is determined by a critical value of the radial magnetic field, that the cathode region is the origin of the instability, and that it may be suppressed in the interelectrode region by controlling the radial magnetic field near the cathode only. Introduction of an axial component of the same order of the radial component required for onset had no effect on instability onset. A supplementary observation shows that a low frequency rotating instability, exhibiting abrupt onset at a critical magnetic field which depends on arc current, has been detected in the exhaust jet and interelectrode region of a moderately high-power MPD arc thruster using argon and an arc power of between 10 and 25 kW. D.H.B.

N68-29916# Boeing Scientific Research Labs., Seattle, Wash. Plasma Physics Lab.
PENETRATION OF A HIGH-FREQUENCY FIELD IN A LOW-PRESSURE PLASMA
M. J. Kofoid and H. V. Cleva Jan. 1968 46 p refs
(D1-82-0706; AD-669470)

Comparisons between calculated and directly measured values of radial penetration of axially-directed magnetic fields in cylindrical plasmas were effected. Using small-amplitude elementary theory the curve of field intensity vs radius was calculated which matched the measured intensity at the axis. The plasmas were intense engough to display considerable skin effect. Author (TAB)

N68-29930 Illinois Univ., Urbana.
ANTENNA IMPEDANCE IN A WARM PLASMA
James Walter Carlin (Ph.D. Thesis) 1967 100 p
Available from Univ. Microfilms: HC $5.00/MF $3.00 Order No. 67-11830

Expressions have been derived for the impedance of biconical and cylindrical dipoles in a warm isotropic plasma. A linearized hydrodynamic description was used as a plasma model. Collisions were neglected throughout as they should modify only the quantitative effects and not the qualitative effects of "plasma" waves on impedance. In determining the impedance of a cylindrical dipole in intimate contact with a plasma, the effect of the induced acoustic sources (force and fluid flux distributions) on the antenna surface must be accounted for in addition to the effects of the induced current distribution. This was accomplished by derivation of a suitable stationary formula for impedance which accounts for the effects of all the induced sources. In general, the effect of the acoustic sources on impedance was found to be quite small. In the treatment of a biconical dipole the antenna was assumed to be encased in an insulating dielectric which is immersed in a plasma. For this model an exact expression was derived for the terminal admittance for very thin antennas. Dissert. Abstr.

N68-29990 Arkansas Univ., Fayetteville.
MAGNETOHYDRODYNAMIC STUDIES IN CYLINDRICAL SYSTEMS WITH POWER GENERATION APPLICATIONS
Martin Jack McCutcheon (Ph.D. Thesis) 1967 135 p
Available from Univ. Microfilms: HC $6.40/MF $3.00 Order No. 67-12884

The analysis of an annular induction magnetohydrodynamic generator from a field theory approach has been made in order to determine the phase impedance, the power factor and the performance characteristics for the model. The flow velocity is assumed constant in the analysis in order to uncouple the electromagnetic and hydrodynamic equations; the resulting solution accounts for the effects of curvature introduced by the geometry; both open channel flow and annular channel flow are considered. The generator phase impedance and power factor are presented in normalized scalable form in terms of the dimensions, excitation, and flow parameters. Several examples are given for both ionized gas and liquid metal flows which illustrate the performance levels which should be achieved with the generator. The results indicate that it may be feasible to construct an experimental generator with liquid metal as the working fluid. The development of a conductivity probe which can be used with an electric shock tube is described also. Dissert. Abstr.

N68-30008*# Scripta Technica, Inc., Washington, D. C.
PLASMOID COLLISIONS IN AN AXIALLY SYMMETRIC MAGNETIC FIELD [STOLKNOVENIYE PLAZMENNYKH SGUSTKOV V AKSIAL'NO-SIMMETRICHNOM MAGNITNOM POLE]
Yu. S. Azovskiy et al NASA Jul. 1968 7 p refs Transl. into ENGLISH from the book "Issledovaniye Plazmennykh Sgustov" Kiev, Naukova Dumka Press, 1967 p 71–79
(Contract NASw-1694)
(NASA-TT-F-11632) CFSTI: HC $3.00/MF $0.65 CSCL 20I

Plasmoid collisions were investigated in axially symmetric magnetic fields using the principle of counter injection into the trap and measuring the emission resulting from the collisions. A strong interaction was found at high strengths of the magnetic field. Author

N68-30031*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
DYNAMICS OF A ONE-DIMENSIONAL PLASMA SHEATH
Frank Hohl and Leo D. Staton Washington Jul. 1968 56 p refs
(NASA-TN-D-4651) CFSTI: HC$3.00/MF$0.65 CSCL 20I

Analytical and numerical methods are used to investigate a bounded one-dimensional plasma with a fixed neutralizing ion background. A variational method is used to show that a large class of stationary solutions of the nonlinear Vlasov equations represent minimum-energy states. The consequence of the minimum-energy property is that the stationary states, which represent minimum-energy configurations, can never be completely reached. However, numerical experiments which simulate the system reveal the interesting property that the plasma approaches its stationary state closely whenever the initial energy is not too different from the energy of this stationary state. Author

N68-30093*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ANALYSIS OF INTEGRATED CHARGED PARTICLE ENERGY SPECTRA FROM GRIDDED ELECTROSTATIC ANALYZERS
F. Reece Roth and Marion Clark (Cornell Univ., Ithaca) Washington Aug. 1968 73 p refs
(NASA-TN-D-4718) CFSTI: HC$3.00/MF$0.65 CSCL 20I

This report relates the shape of the retarding potential curve produced by gridded electrostatic analyzers to the floating potential, the kinetic temperature, and the half-angle subtended in velocity space by the particles. Special emphasis is placed on the case in which the particles are Maxwellianized, but restricted within an escape cone in velocity space of half-angle. The cases of pulsed and steady state supply of particles are both considered. A computer program is included which produces an iterated best fit of experimental integrated energy spectra to these analytical expressions, and provides the effective values of the kinetic temperature, floating potential, and escape cone angle. A series of experimental runs is analyzed with the computer program as an illustrative example, and the possible sources of error are discussed. Author

N68-30115# Ohio State Univ., Columbus.
AN ANALYTICAL STUDY OF A FLUID CYLINDER ARC MODEL BALANCED BY CROSSED MAGNETIC AND FLOW FIELDS Final Report, 1 Nov. 1966–31 Oct. 1967
D. H. Kihara and L. S. Han Wright-Patterson AFB, Ohio ARL Jan. 1968 105 p refs
(Contract F33615-67-C-1176)
(ARL-68-0019; AD-669354)

A free-burning electric arc subjected to a cross-flow and a cross magnetic field is represented by an impermeable fluid cylinder model. This model allows for both momentum and energy exchange processes by viscous forces and conductive heat transfer around the cylindrical surface. Convective effects through the surface are assumed not to occur. The fluid dynamic and heat transfer characteristics within and outside the fluid cylinder model are investigated by proper matching of both flow and temperature fields at the cylinder boundary. The study shows that the arc radius and centerline temperature can be calculated provided the magnitudes of the applied external fields are known. The external fields are the electric field, the magnetic field and the cross flow field. The relationship among these parameters for a nitrogen arc is shown graphically. Author (TAB)

N68-30116# Minnesota Univ., Minneapolis. Dept. of Electrical Engineering.
TRANSPORT OF CHARGED PARTICLES THROUGH GASES AND PLASMAS Final Report, 1 Jan. 1966–1 Jan. 1968
H. J. Oskam Bedford, Mass. AFCRL Mar. 1968 26 p refs
(Contract AF 19(628)-5814)
(AFCRL-68-0149; AD-670176)

Results obtained from a theoretical and experimental study of the transport of charged particles through gases and plasmas are summarized. Experimental current-voltage characteristics of a cylindrical hot cathode gas diode filled with various gases have been compared with theoretical curves obtained when using experimental electron drift velocity data in the calculations. Good agreement was obtained. An experimental tube for studying the influence of space-charge neutralization by positive ions on current-voltage characteristics has been constructed. Application of macroscopic transport equations to the theory of electrophoresis results in a new formulation of this phenomenon. The same method was applied to the theory of cataphoresis. A theoretical study of radial gas density variations in direct current discharge tubes was started. Author (TAB)

N68-30162# Oak Ridge National Lab., Tenn. Thermonuclear Div.
ON THE FEASIBILITY OF POWER BY NUCLEAR FUSION
D. J. Rose May 1968 156 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-2204) CFSTI: HC$3.00/MF$0.65

Power from nuclear fusion will be feasible if certain plasma physics and engineering problems can be solved simultaneously: Equilibrium plasma properties discussed here are the thermalization rates between ions, electrons, and fusion α particles; fuel burnup fractions for given electron and ion temperatures, given injection or heating energies, and specified plasma environmental conditions. The effect of the presence of α-particles and of unequal particle temperatures on plasma pressure and reaction rate are calculated. Typical operating conditions for a variety of plasmas typical of open or closed magnetic confinement systems are shown. New solutions to outstanding engineering problems are indicated, viz: a cellular niobium vacuum wall, cooled with lithium or fused salt; a beryllium or BeO pebble-bed moderator, with added graphite; magnetic stress supports of titanium. Many subsidiary problems are discussed. It is shown that fusion systems with output in the order of 10,000 electric megawatts may be economically attractive; cost of the fusion system "core" lies between $10 and $20/kWe, depending upon circumstances. The desired operating parameters in an open-ended fusion system many be achieved if the plasma pressure is a substantial fraction of the magnetic pressure, but not otherwise, and the task will be difficult. Closed magnetic field configurations will be more attractive, provided stability and system size problems can be satisfactorily resolved. The relevance of the studies to present fusion research is indicated. Author (NSA)

N68-30181# Aerospace Research Labs., Wright-Patterson AFB, Ohio. Plasma Physics Research Lab.
A USERS MANUAL FOR A COMPUTER PROGRAM TO REDUCE SPECTROGRAPHIC DATA FROM A ROTATIONALLY SYMMETRIC PLASMA Final Scientific Report
John P. Oss Jan. 1968 79 p refs
ARL-68-0003; AD-670170I

A computer program for the reduction of monochromator data from a circular cylindrical plasma column is described in detail. A manual for use of the FORTRAN IV programs is provided along with detailed specifications and listings of the programs. The Abel inversion problem is handled by fitting experimental emission and absorption data to a Jacobi polynomial and inverting the polynomial. The programs presented were used in the reduction of

optically thick sources with a typical calculation time of one second when 50 input data points are used and 20 output data points are calculated on an IBM 7094. Author (TAB)

N68-30238# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Gas Ionizzati.
PLASMA FOCUSING IN MIRAPINO
J. G. Linhart and C. Maisonnier Dec. 1967 30 p refs Sponsored in part by EURATOM
(LGI-67-26) CFSTI: HC $3.00/MF $0.65

The focalization of plasma is of interest in the research on pulsed fusion reactors and pulsed fusion neutron-sources. One of the processes by means of which one can hope to obtain dense and hot hydrogen plasma is related to the MIRAPI experiments. In these a plasma liner collapses on an hydrogen plasma-core, converting a part of its kinetic energy in the thermal energy of the core, at the same time confining it. The production and convergence of these liners is a diffucult problem to which several solutions were proposed. One of these suggests that relatively thin and geometrically weak well-defined liners can be produced by snow-ploughing heavy gas, such as Argon and Xenon. This process was often investigated in cylindrical geometry in discharges in hydrogen, but only rarely in heavier gases. Calculations were done on quasi-spherical snow-ploughs showing that using suitably shaped initial gas-volumes, a volume-collapse by a factor of 1600 can be expected. In order to set some basic information on snowploughs in heavy gases (mainly Argon) in cylindrical and quasi spherical vessels an experiment called MIRAPINO was prepared. It was supposed to furnish some data on the degree of gas-sweeping in cylindrical, oval and spherical discharge tubes, on the thickness of snowploughed plasma-layer and on the transfer of the liner-energy to a compressed axial magnetic field. In the first part of this study the apparatus is described as well as the measurements. The results of these measurements are interpreted. Author (ESRO)

N68-30264# United Kingdom Atomic Energy Authority, Culham (England). Culham Translations Office.
MEASUREMENT OF THETA PINCH PARAMETERS IN AN AZIMUTHAL MAGNETIC FIELD
Ya. F. Volkov, V. G. Dyatlov, and N. I. Mitina Nov. 1967 9 p refs Transl. into ENGLISH from Zh. Eksperim. Teor. Fiz. (Moscow), v. 37, no. 10, 1967 p 1792–1796
(CTO/446; NP-TR-1633) CFSTI: HC $3.00/MF $0.65

A helium plasma produced in a theta pinch discharge with an azimuthal magnetic field was investigated. The time dependence of the electron temperature and plasma density was measured for different pressures in the system with and without an applied azimuthal magnetic field. The electron temperature was measured by optical methods from the relative intensities of the helium lines and from the absorption of soft x radiation in an aluminum foil. Author (NSA)

N68-30267# United Kingdom Atomic Energy Authority, Culham (England). Culham Translation Office.
VALIDITY CONDITIONS OF THE RANDOM PHASE APPROXIMATION FOR NON-LINEAR WAVE INTERACTION IN A PLASMA
G. M. Zaslavskii Sep. 1967 8 p refs Transl. into ENGLISH from RUSSIAN preprint
(CTO/425; NP-TR-1634) CFSTI: HC $3.00/MF $0.65

A dynamic equation is considered describing the nonlinear interaction of waves of small amplitude in a plasma with discrete spectrum. The condition in which the random phase approximation is valid is obtained. The criterion depends on the form of the spectrum, the amplitude of the waves, and the distance between the harmonics in the spectrum. It is shown that in the limiting case of a continuous spectrum the random phase criterion is fulfilled automatically. The limit is determined for the spectrum of waves for which the kinetic equation is valid. Author (NSA)

N68-30283*# Alabama Univ. Research Inst., Huntsville.
GENERALIZED OHM'S LAW IN MULTIFLUID SYSTEMS
Shi-tsan Wu May 1968 60 p refs
(Grant NGL-01-002-001)
(NASA-CR-95884; UARI-49) CFSTI: HC $3.00/MF $0.65 CSCL 20I

A generalized Ohm's law in multifluid systems under non-Local-Thermodynamic-Equilibrium (non-LTE) is derived through the macroscopic description of the Boltzmann equation. It is shown that the first order approximation can be written as a function of the electric and magnetic field. The second order approximation is shown to be a function of the electric and magnetic field with the effects of the gradients of density, temperature, and mean flow velocity of individual mixture components, and of the effects of the internal degrees of freedom of the particles. The derivation is limited to a slightly ionized gas. Some applications in the area of astrophysical problems are discussed. Author

N68-30290*# Institute of Modern Languages, Inc., Washington, D. C. Translation and Interpretation Div.
THE RESONANCE PROBE [LA SONDE A RESONANCE]
Dimitri Lepechinsky, A. Messiaen, and P. Rolland Washington NASA Jul. 1968 24 p refs Transl. into ENGLISH of Comm. a l'Energie Atomique, Centre d'Etudes Nucl., Saclay (France), 1966 Rept. CEA-R-2945 For FRENCH original see N67-33227
(Contract NASw-1693)
(NASA-TT-F-11666) CFSTI: HC $3.00/MF $0.65 CSCL 20I

The experimental findings of the report indicate satisfactory agreement with the theoretical expectations of Messiaen, Lepechinsky, and Rolland concerning electron density as furnished by antiresonance, the thickness of the sheaths, and even the frequency of "neutral electron" collisions. The simplified theory of the authors is based on hydrodynamic equations with adequate limit conditions and accounts well for the essential phenomena observed. This holds true also for other problems of resonance of the same kind, provided conditions are such that non-collision damping is not destroyed by resonance which is certainly not random. Experimentation to determine the limits of application of the simplified theory and to measure non-collisional effects is under way. Author

N68-30295*# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
EXPERIMENTAL AND ANALYTICAL STUDIES OF PLASMA TRANSPORT PROPERTIES Semiannual Progress Report, 1 Dec. 1967–31 May 1968
Daniel Bershader 1 Jul. 1968 34 p refs
(Grant NGR-05-020-091)
(NASA-CR-95874) CFSTI: HC $3.00/MF $0.65 CSCL 20I

A summary of technical progress during the six-month period, December 1, 1967–May 31, 1968 is presented. The theoretical effort consisted in extending the work reported earlier on the development of formulas for the calculation of transport coefficients of a stable, multicomponent plasma in the presence of a magnetic and an alternating electric field, in accordance with the Chapman–Enskog theory. Numerical values of electron thermal and electrical conductivities for helium and argon have been evaluated and compared. Major results of the recent experimental effort include a successful evaluation of electron density profile in the thermal boundary layer behind the reflected shock. Information has also been obtained on the nonequilibrium ionization–wave interactions in the reflection shock regime. Instrumentation work continued on a more sophisticated thin film heat transfer gauge for use in ionized gases; as well as continuing work on extending the capabilities of the high response capacitative end wall pressure gauge. Author

N68-30301# Stanford Univ., Calif. Inst. for Plasma Research.
STUDIES OF PLASMA OSCILLATIONS Status Report No. 31, 1 Aug. 1967–31 Jan. 1968
F. W. Crawford, J. R. Forrest, S. A. Self, and A. Duncan Feb. 1968 35 p refs
(Contract AT(04-3)-326)
(SU-IPR-224) CFSTI: HC $3.00/MF $0.65

Further research results are described for each of the following: (1) ion wave propagation and positive column instabilities, (2) cyclotron echoes and collision measurements, (3) cyclotron harmonic wave phenomena, and (4) beam–plasma interactions. NSA

N68-30304# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
ON ELECTROMAGNETIC GAIN MECHANISMS IN PLASMAS
M. R. Wohlers Jul. 1968 23 p refs
(RM-419)

If a plasma is active, i.e., capable of transferring net energy to the electromagnetic waves propagating through it, then some electromagnetic gain mechanism is present within it. The conditions under which a linearized plasma will be active are derived and used to discuss some bulk gain mechanisms in a typical solid state plasma. A specific example is given to demonstrate that the concepts of activity and instability are mutually independent, i.e., a plasma may be active enen though the wave propagating through it are stable both temporally and spatially. The same example predicts the existence of a bulk gain mechanism in homogeneous solid state plasmas that is of particular interest since it is present no matter how small the static currents that are responsible for it become. Author

N68-30331# Stichting voor Fundamenteel Onderzoek der Materie, Jutphaas (Netherlands). Instituut voor Plasma-Fysica.
TIME-DEPENDENT AUTOCORRELATION FUNCTIONS FOR THE LIGHT SCATTERED BY A TURBULENT MEDIUM
L. Pieroni and H. Bremmer Apr. 1967 40 p refs Sponsored by EURATOM
(NP-17456; Rept.-67-38)

The following problem is considered: suppose a slab, confined between two infinite planes perpendicular to the z direction of a reference system, containing a slightly inhomogeneous medium characterized by a dielectric constant $\epsilon = \bar{\epsilon} + \delta\epsilon(x,y,z,t)$, with $\delta\epsilon\sqrt{\bar{\epsilon}} << 1$. This model is used as an example for more general weakly inhomogeneous media to which the present theory may be applied just as well. NSA

N68-30379# United Kingdom Atomic Energy Authority, Culham (England). Culham Translations Office.
OSCILLATORY STRUCTURE OF A QUASI-STATIONARY MAGNETOHYDRODYNAMIC SHOCKWAVE IN A PLASMA
G. G. Dolgov–Savelev, V. K. Malinovskii, and Yu. E. Nesterikhin Jan. 1968 10 p refs Transl. into ENGLISH from Zh. Prikl. Mekhan i. Tekhn. Fiz. (Moscow), no. 4, 1967 p 111–112
(CTO-465; NP-TR-1643) CFSTI: HC $3.00/MF $0.65

The equipment and techniques for studying the shock structure of a flowing plasma about a stationary object are briefly discussed. NSA

N68-30547# Air Force Cambridge Research Labs., Bedford, Mass. Microwave Physics Lab.
AN EXPERIMENTAL STUDY OF SIMULATED PLASMA-COVERED SLOTS
N. V. Karas and J. D. Antonucci Mar. 1968 29 p refs *Its* Phys. Sci. Res. Papers, No. 355
(AFCRL-68-0152; AD-669804)

The effect of a lossless isotropic plasma on the admittance of a waveguide slot terminating in a ground plane has been studied by means of a plasma simulation technique. The relative dielectric constant between the plasma and freespace was maintained by using two contiguous real dielectric materials. Freespace was simulated by an alumina powder of high dielectric constant, and the plasma by a material of lower dielectric constant. The admittance of the slot radiator was measured by (a) a direct method, (b) Deschamps method, (c) a tuner method. All three gave similar results. Experimental values were determined for the normalized aperture admittance of a slot covered by a simulated plasma of thickness varying from asymptotically equal to 0.1 in. to infinity. The results showed good agreement with theory. Author (TAB)

N68-30593*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
SOME INTERACTIONS OF POLYCRYSTALLINE TUNGSTEN ELECTRODES WITH CESIUM PLASMAS
James F. Morris Washington Aug. 1968 17 p refs
(NASA-TN-D-4745) CFSTI: HC $3.00/MF $0.65 CSCL 20I

At thermionic diode temperatures, work functions of tungsten electrode surfaces depend strongly on positive ion sheaths between these electrodes and cesium plasmas. The present theoretic study demonstrates this effect for a plane field-modified emitter with a collisionless positive ion sheath in a thermally ionized plasma. The analysis covers temperatures from 1700° to 2600°K; plasma electron number densities of 10^{12}, 10^{13}, and 10^{14} cm^{-3}; and a bare work function of 4.59 V. Values for sheath voltages, work functions, and cesium arrival rates and coverages on tungsten result from equilibrium calculations. In addition to these variables, computations for elevated plasma electron temperatures yield net current densities. Throughout this work, the sheath drops lie below 1 V. And atom arrival rates approach total cesium arrival rates only at low temperatures and sheath voltages. Author

N68-30614# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
RESEARCH ON PLASMADYNAMICS AND MAGNETOGASDYNAMICS Final Technical Report, 1 Mar. 1966–28 Feb. 1968
J. H. de Leeuw May 1968 11 p refs
(Grant AF-AFOSR-366-66)
(AFOSR-68-1196; AD-670158)

Report summaries are included on the following topics: theory of spherical and cylindrical electrostatic probes, magnetohydrodynamic flow in the shock tube boundary layer, supersonic flow of compressible plasmas in a magnetic field, ionization processes in strong shock waves, and magnetohydrodynamic flow near a stagnation point. Other unpublished results are also summarized. Author (TAB)

N68-30618# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATION OF EXTRACTION AND FORMATION OF ION BEAMS IN PLASMA SOURCES [ISSLEDOVANIYE IZVLECHENIYA I FORMIROVANIYA IONNYKH PUCHKOV V PLAZMENNYKH ISTOCHINIKAKH]
V. I. Rayko 9 Oct. 1967 16 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR, Inst. At. Energii (Moscow), no. 974, 1965 p 1–19
(FTD-MT-24-231-67; AD-670078)

Methods of increasing the yield of an ion source for an electromagnetic separator on the basis of selecting the optimum geometry for the ion-optical system are discussed. Ion beam dispersion in the plane of the trajectory at the output was studied as a function of the main characteristics of the source. Sources used for the separation of stable isotopes over a wide range of isotope masses were analyzed and the effect of uncompensated

positive space charge in the beam was evaluated. A graph is given showing current density as a function of ion mass for various ion-optical geometries. The results of the research were used to design a separator for lead ions that have a PB current density of approx. 50 ma/sq cm, representing an improvement over previous ion-optical systems of one order of magnitude. Author (TAB)

N68-30656#
ON THE STRUCTURE OF SHOCKWAVES OF AN ELECTRODELESS DISCHARGE IN AIR AND ARGON
Z. A. Pietrzyk, R. I. Solokhin, and S. Zh. Toktomyshev 1968 10 p refs Transl. into ENGLISH from Prikl. Mekhan. i Tekhn. Fiz. (Moscow), no. 4, 1967 p 104–110
CFSTI: HC $3.00/MF $0.65

Results are presented of systematic measurements (using three independent methods) of the plasma temperature distribution behind strong shock fronts in air and argon, and peculiarities of the formation and propagation of shocks in electrodeless discharge tubes are discussed. S.C.W.

N68-30671# Polish Academy of Sciences, Warsaw.
KINETIC DESCRIPTION OF PLASMA IN EXTERNAL FIELD. 1: GENERAL THEORY [ROWNANIE KINETYCZNE DLA PLAZMY W POLU ZEWNETRZNYM. 1: TEORIA OGOLNA]
A. Kuszell and A. Senatorski 1968 27 p refs Submitted for publication
(P-886/XXI/PP) CFSTI: HC $3.00/MF $0.65

The formal solution of the Liouville equation for systems in an external inhomogeneous, nonstationary, electromagnetic field based on perturbation theory is found. Generalization of Prigogine–Balescu diagram technique is proposed and time behavior and volume dependence of new matrix elements is investigated. The kinetic equation in Vlasov approximation in the presence of an external electromagnetic field is rederived. General Master equation is obtained and asymptotic limit for long times is discussed. Author

N68-30672# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
ON THE THEORY OF OHMIC HEATING OF FULLY IONIZED PLASMAS
H. Schrade, W. Bez, K. Hocker (Tech. Univ. of Stuttgart), and H. Kaeppeler Jul. 1968 36 p refs Transl. into ENGLISH from Z. Naturforsch. (Tubingen), v. 15a, issue 2, 1960
(TR-49)

Starting from a solution of the Boltzmann equation by means of the 13-moments-approximations extended for plasmas, the equations for Ohmic heating of fully ionized plasmas are set up. The influence of a magnetic field is neglected. As additional approximations, the anisotropic component of the pressure tensor, and the heat flux vector are neglected in the orthogonal series expansion for the probability density, which results in a local Maxwellian distribution. These omissions are justified in detail. The collision integrals appearing in the equations simplified in this manner are computed at a Coulomb potential cutoff at the Debye radius. Thus a simultaneous system of differential equations is obtained which is suited for the practical calculation of the Ohmic heating with arbitrarily strong electric fields. Author

N68-30707# Gosudarstvennyi Komitet Po Ispolzovaniyu Atomnoi Energii, Obninsk (USSR). Fiziko-Energeticheskii Institut.
VOLT-AMPERE CHARACTERISTICS OF LOW-VOLTAGE ARC DISCHARGE [O VOL'T-AMPERNYKH KHARAKTERISTIKAKH NIZKOVOL'TNOGO DUGOVOGO RAZRYADA]
I. P. Stakhanov and I. I. Kasikov 1967 23 p refs In RUSSIAN
(FEI-95)

An approximate analytic formula is derived for the volt–ampere characteristic with negative resistance for low-voltage arc discharges. It is shown that in the absence of recombination the arcing temperature weakly depends on the current and the interelectrode distance. When the ionization losses are low the branch of the volt-ampere characteristic with negative resistance is realized. As the loses increase, the curve of the characteristic becomes normal. NSA

N68-30732* Techtran Corp., Glen Burnie, Md.
PROBLEMS ON THE EXISTENCE OF OPEN- AND CLOSED-FORM SHOCKS IN MAGNETOHYDRODYNAMIC SHOCK WAVES
Ch'en Jen Washington NASA Jun. 1968 9 p refs Transl. into ENGLISH from Wu Li Hsueh Pao (Peking), v. 22, no. 9, 1966 p 1098–1102
(Contract NASw-1695)
(NASA-TT-F-11699) CFSTI: $3.00 CSCL 20I

In spite of the extensive literature on the subject, the basic form of open- and closed-form shock waves in magnetohydrodynamic shock waves remains open, as well as the possibility of their existence from a physical standpoint. The authors present the basic equations for magnetohydrodynamic shock waves on the assumption that suitable, fixed coordinates can be selected on the wave plane. Limitations on the possibility of formation of open-form shock waves are presented. The mathematical discussion presented shows that the adiabatic equations of open-form shocks and closed-form shocks cannot be the same as the equation for normal shock waves or magnetohydrodynamic shock waves. The data indicate that middle shock waves can occur more easily than open-form shocks. The middle shock waves would be of the unstable type. They would split into many shock waves with greatly decreasing intensity. Author

N68-30788# Paris Univ., Orsay (France). Laboratorie de Physique des Plasmas.
KINETIC THEORY AND RELAXATION PROCESSES OF WEAKLY IONIZED GASES
J. L. Delcroix, A. Constantin, M. Fitaire, J. Godart, E. Leiba et al Feb. 1968 34 p refs
(Contract F61052-67-C-0048)
(AFCRL-68-0237; AD-670218)

An analytic method to calculate the electronic distribution function in weakly ionized plasma in equilibrium between Joule effect and elastic and inelastic collisions is presented. The results of experimental measurements of the recombination coefficients for plasmas induced by laser are compared with the theoretical ones given by Bates, et al, for hydrogen, after having made an extension of the helium gas. An experiment was conducted to determine the high frequency field influence on a plasma column (mercury vapor at a .001 Torr pressure and electronic density of the order of 10 to the 11th power/cc). The results are given in terms of the ionization of the plasma by the wave and the parametric generation of the low frequency wave. A finite plasma, having numerous resonance regions, behaves like a parametric amplifier when a small signal is applied on one of these resonances. An experiment is presented where a 2 mW signal at 2700 MHz is amplified with a power gain of 170, the band width being less than 1 MHz. The principles of the non-linear coherent interaction of two waves in a plasma were verified in the neighborhood of two resonances, cyclotron resonance and hybrid resonance. The non-linear effect could provide a diagnostic means. The density measurement of the central zone of the studied plasma was performed with a good precision. A new measuring device using three directional couplers and providing an easy way to measure the complex reflection and transmission coefficients of a two-terminal-pair structure is described. Author (TAB)

N68-30784*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SHAPE OF A MAGNETICALLY BALANCED ARC
Marvin E. Goldstein and Willis H. Braun Washington Aug. 1968 34 p refs
(NASA-TN-D-4736) CFSTI: HC$3.00/MF$0.65 CSCL 20I

An improved model is developed for predicting the shape of an electric arc balanced in transverse convective and magnetic fields. The improvement over the previous model is in the more accurate description of the external flow field. The techniques used are based on conformal mapping and are an extension of those methods developed for problems of free surface flows. Author

N68-30811*# National Aeronautics and Space Administration, Washington, D. C.
HIGH TEMPERATURE ENERGY SYSTEMS WITH PLASMA REACTORS AND INDUCTIVE MAGNETOPLASMA-DYNAMIC CONVERTORS [HOCHTEMPERATUR-ENERGIESYSTEME UNTER VERWENDUNG VON PLASMAREAKTOREN UND INDUKTIVEN MAGNETOPLASMADYNAMISCHEN WANDLERN]
W. Peschka Jun. 1968 14 p refs Transl. into ENGLISH from Deut. Versuchanstalt fur Luft- und Raumfahrt, Inst. fur Energiewandlung und Elek. Antriebe (Stuttgart), Sep. 1967 Rept. DLR-FB-67-59 For original Ger. see N68-11139
(NASA-TT-F-11825) CFSTI: HC$3.00/MF$0.65 CSCL 20I

This paper investigates possible future power generating equipment which operates with high temperature plasma as a working medium and subsequently with high power density. This temperature range requires reactors whose nuclear fuel is in the plasma state (fission or fusion reactors) coupled to magnetoplasma-dynamic generators acting as energy converters. Electrodeless MPD-generators with all their advantages can be successfully employed. The technological ramifications arising from the application of these high temperatures with respect to the reactors and the MPD-generators as well as to the heat release equipment are discussed. Author

N68-30815# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
MONOCHROMATOR MEASUREMENTS OF ION VELOCITIES IN A ROD PLASMA INJECTOR
S. Suckewer, S. Kulinski, and J. Nowikowski 1968 22 p refs Presented at 3rd Intern. Conf. on Controlled and Plasma Physics, Novosibirsk, USSR, Aug. 1968
(P-883/XVIII/PP) CFSTI: HC$3.00/MF$0.65

The axial speeds of different groups of ions were measured in a rod plasma injector with the aid of monochromator. The main result of these measurements was that the velocities of different groups of ions were practically equal. It appeared also that all the groups of ions are mixed in a plasmoid and there does not exist any ordered pattern, concerning the distribution of ions in the plasmoid. The speed of the plasmoid was also estimated with the aid of ultrafast photography. A reasonable good agreement was observed between the velocities of ions and those of plasmoids. The discussion of the obtained results was carried out as well as the attempts were made to find a suitable theoretical explanation of these results. Author

N68-30825# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
SHOCK WAVE STRUCTURE IN GAS MIXTURES AND PLASMAS
S. R. Sinclair May 1968 106 p refs
(Grant AF-AFOSR-278-66)
(UTIAS-130; AFOSR-68-0576; AD-669570)

The research was concerned with a theoretical description of shock wave structure in gaseous mixtures when diffusive effects are important. The problem considered in detail is the structure of a shock wave in a helium-argon mixture in which the argon is present in very small concentration. An anomalous result, cited in the literature, suggesting that the argon undergoes an initial pre-expansion before compression, was analysed to show the theoretical origin of this effect. The velocity distribution of a trace of heavy gas (and its lower moments) are watched as the heavy particles pass through a Mott-Smith background shock of lighter particles. The Mott-Smith background is chosen because its bimodal Maxwellian form provides an analytical determination of the free path to the next event for the heavy test particle at any point along its trajectory. This so-called Monte Carlo solution to the idealized diffusion shock problem can be used as a standard for evaluating the diffusion equations derived from various kinetic theory approximations. A number of systems of moment equations of the heavy particle Boltzmann equation were solved and the resulting heavy particle moment profiles compared with those of the Monte Carlo solution. A second strong diffusion problem was analysed from a kinetic theory point of view. It was found experimentally that the ion density profile through a shock in a weakly ionized plasma with elevated electron temperature is much more diffuse than the neutral atom shock. The theoretical analysis shows that this strong diffusion effect can be attributed to the electrical coupling between the ions and the hotter electron gas. Author (TAB)

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N68-29564# Ohio State Univ., Research Foundation, Columbus.
THE CHARGE MECHANISM IN FERROELECTRICS Final Report, Apr. 13, 1967–Apr. 12, 1968
Donald D. Glower 9 May 1968 5 p
(Grant DA-ARO(D)-31-124-G924)
(Rept.-2; AROD-6708-1.E; AD-669261)

The charge transport mechanisms in lead zirconate titanate (Pb(ZrxTi1-x)O3) have been investigated over the range of temperatures from 650 degrees K to 1000 degrees K, by means of an electrochemical concentration cell. Very interesting results have been obtained at the higher temperatures, above 800 degrees K. These data suggest that the electrical conductivity, which is primarily ionic at these temperatures, exhibits an isolated peak in electronic conductivity at a temperature which increases with titanium concentration. Existing electrical shielding problems will soon be solved so that the measurements can be extended to lower temperatures, which will include the ferroelectric phase. Author (TAB)

N68-29568# Massachusetts Inst. of Tech., Cambridge. Electrical Engineering Dept.
A MAGNETOREFLECTION STUDY OF ARSENIC AND BISMUTH
Martin Sidney Maltz Jun. 1968 83 p refs
(Contract Nonr-1841(72))
(TR-7; AD-669439)

The report describes studies of the band structure of the semimetals, arsenic and bismuth, using the magnetoreflection technique. In arsenic, two new series of oscillations in the magnetoreflectivity have been found. One series of oscillations, observed when the magnetic field is perpendicular to the trigonal axis, seems to be associated with direct interband transitions between two bands with a critical point at T in the Brillouin zone. A second series of oscillations is observed when the magnetic field is parallel to the trigonal axis and is associated with direct interband

transitions between two bands with a critical point along the Q axis in the Brillouin zone, using the symmetry notation of Lin and Falicov. Oscillations in the magnetoreflectivity were also observed for bismuth. These oscillations are associated with direct interband transitions between the valence and electronic conduction bands, which have a critical point at L in the Brillouin zone. The lineshape of the oscillations in the magnetoreflectivity were calculated, using the Lax model. TAB

N68-29574 Syracuse Univ., N. Y.
PHOTOCONDUCTIVITY IN INDIUM-GALLIUM-ANTIMONY AND INDIUM-GALLIUM-ARSENIC ALLOY SYSTEMS
Joseph Stephen Wrobel (Ph.D. Thesis) 1967 116 p
Available from Univ. Microfilms: HC $5.80/MF $3.00 Order No. 67-12091

The photoconductive response of the systems InSb-GaSb, and InAs-GaAs were investigated. A uniform variation of the intrinsic threshold with composition was observed. In addition, the effects of impurities on these systems was determined. In particular, the variation of the .023 eV acceptor level of GaSb in InSb-GaSb alloy system, and zinc and chromium in the system InAs-GaAs, were studied as a function of composition. The former was investigated by the temperature variation of the Hall constant, and exhibited a uniform variation with composition tending to smaller activation energies as the composition becomes richer in InSb. The latter was investigated by the shift in extrinsic photoresponse. Photosensitivity at higher temperatures was increased for GaAs rich samples doped with chromium, while InAs rich samples could be made photosensitive by the addition of zinc. The extrinsic threshold for zinc doped-InAs yields an acceptor level at about .03 eV above the valence band as predicted from a Hydrogenic impurity model. The variation of extrinsic response for chromium doped GaAs and InAs-GaAs samples shows a linear variation of the deep trap for samples up to 57% InAs. Dissert. Abstr.

N68-29575 Pennsylvania Univ., Philadelphia.
LOCAL, NON-LOCAL AND QUANTUM MAGNETOPLASMA EFFECTS IN PBTE
Sidney Perkowitz (Ph.D. Thesis) 1967 182 p
Available from Univ. Microfilms: HC $8.40/MF $3.00 Order No. 67-12792

An experimental and theoretical study of magnetoplasma phenomena in the multi-ellipsoid semiconductor PbTe has been carried out. These phenomena include cyclotron resonance and related effects (i.e., hybrid resonance, tilted-orbit cyclotron resonance and the dielectric anomaly) at low magnetic fields, and propagating-mode effects (helicons and Alfvén waves) at higher fields. In a semiconductor, such phenomena are usually considered only in the local limit, that is, where the spatial dependence of the electric field E inside the medium is negligible. In PbTe, however, the spatial dependence of E is significant, and in this non-local case, new effects arise; these include the well-known Azbel–Kaner and Doppler-shifted cyclotron resonances. The theoretical portion of the present work is concerned with the elucidation of the wide variety of local anisotropic effects occurring in PbTe, and an analysis of the role of non-locality in PbTe. Dissert. Abstr.

N68-29578 Iowa State Univ. of Science and Technology, Ames.
SHAPE INDUCED BIAXIAL ANISOTROPY IN THIN MAGNETIC FILMS
Fred Shing-Chung Lee (Ph.D. Thesis) 1967 72 p
Available from Univ. Microfilms: HC $4.00/MF $3.00 Order No. 67-12975

Measurements taken from a star-shaped film which was etched from a planar uniaxial film yielded a large biaxial anisotropy term, indicating that sufficient biaxial anisotropy can be shape induced to make a potentially useful biaxial memory element. In analyzing the effect, the discrete and quasi-equilibrium M-distributions, which were oriented in the average directions of 90° (high energy state) and 45° (low energy state) with respect to the film axis, were obtained under minimum energy conditions in the presence of the demagnetizing and orienting fields. The calculated biaxial anisotropy was then obtained under the assumption that all the excess energy of the 90°-distribution over that of the 45°-distribution can be attributed to the biaxial property of the film. A simple formula was derived to estimate the biaxial anisotropy field H_{K_2} of the star-shaped film. Dissert. Abstr.

N68-29586 Wisconsin Univ., Madison.
SUPERCONDUCTING TRANSITIONS OF ISOTOPES OF ZINC
Robert Earl Fassnacht 1967 62 p
Available from Univ. Microfilms: HC $3.60/MF $3.00 Order No. 67-8995

The effect of isotopic mass on the superconducting transition temperature T_c of An has been investigated in three highly purified samples with average isotopic masses of 63.98, 65.91, and 67.94. By extrapolating critical magnetic field curves to zero field, values of 0.856, 0.849, and 0.841°K were obtained for T_c of Zn^{64}, Zn^{66}, and Zn^{68} respectively. Specific heats calculated from these critical field curves are compared with direct measurements made by others. The superconducting-to-normal transition of a sample was observed to broaden as the applied magnetic field was reduced below some small value. Ratios of transition widths in zero field and in the earth's field ranged from about 2 to over 30 depending on the sample. An appendix contains descriptions and explanations of some of the apparatus used in the course of this work. Dissert. Abstr.

N68-29587 Columbia Univ., New York.
NUCLEAR SPIN-LATTICE RELAXATION IN SUPERCONDUCTING VANADIUM
Warner Fite, II (Ph.D. Thesis) 1966 130 p
Available from Univ. Microfilms: HC $6.20/MF $3.00 Order No. 67-9336

A nuclear spin-lattice time, T_1 in the superconducting state of vanadium has been measured from the transition temperature using a field cycling method. The sharp drop in T_1 just below T_c exhibited by aluminum and other metals was not found, but the results do not disagree with BCS theory if the effect of flux trapping is considered. As $T \to 0$, T_1 was found to increase exponentially as expected yielding a value for the energy gap consistent with BCS theory and other measurements. This result disagrees with T_1 measurements in multiple thin films of vanadium made by others. Normal state T_1 measurements in high field were made to 1.4°K yielding a value of T_1T consistent with other measurements made at higher temperatures. The field dependence of T_1 in vanadium was also measured at 5.3°K. Dissert. Abstr.

N68-29588 Rutgers Univ., New Brunswick, N. J.
LARGE ANGLE ELASTIC SCATTERING OF ENERGETIC PROTONS IN SILICON SINGLE CRYSTALS
Leonard Cecil (Ph.D. Thesis) 1967 202 p
Available from Univ. Microfilms: HC $9.25/MF $3.00 Order No. 67-9247

Large angle elastic scattering of protons of MeV energies from silicon single crystals has been studied. In general, the ordered arrangement of the nuclei that exists in a single crystal is shown to have a large effect on the elastic scattering yields (as compared to an amorphous target with the same number of scattering centers) when certain angular relations are satisfied among the incident beam direction, the scattering direction, and low-index crystalline directions. Experiments in which the incident beam is parallel to a principal direction of the crystal (channeling) and

investigations in which the scattered particle emerges parallel to a principal direction (blocking) are analyzed and discussed. Dissert. Abstr.

N68-29589# Frankford Arsenal, Philadelphia, Pa. Pitman Dunn Research Labs.
A STUDY OF EXCITON STATES IN ELECTRIC AND MAGNETIC FIELDS
Max E. Caspari, Michael A. Shields, and Issai Lefkowitz Feb. 1968 16 p refs
(FA-M68-25-1; AD-669619)

The effect of static applied magnetic and electric fields on excitons is considered in terms of the Wannier exciton. Considering the fields as first order perturbations, the Hamiltonian for the system is derived. An experimental investigation of electrical and magnetic field effects on these exciton states is discussed. Author (TAB)

N68-29605 Wisconsin Univ., Madison.
THE DE HAAS–VAN ALPHEN EFFECT IN UNIAXIALLY STRESSED BISMUTH
Francis Frowin Huppe (Ph.D. Thesis) 1967 107 p
Available from Univ. Microfilms: HC $5.40/MF $3.00 Order No. 67-495

The relative change in the de Haas-van Alphen (dH-vA) frequency as a function of uniaxial compression has been measured for the classical electron and hole oscillations in bismuth single crystals. Field modulation techniques were used at liquid helium temperatures in magnetic fields up to 9 kG. Variable stress up to 250 kg/cm^2 could be applied remotely to the sample without removing it from the helium bath. In addition to the normal electron and hole oscillations a previously unreported oscillation was observed. This "mystery" frequency behaves in many ways like an ordinary dH-vA oscillation arising from a long, cigar-shaped ellipsoid of revolution about the trigonal axis of the crystal. The oscillation is periodic in 1/H; its frequency *vs.* angle plot fits an ellipsoidal theoretical curve in the entire range for which experimental points are available; and conventional amplitude *vs.* temperature measurements yield an effective mass value. Dissert. Abstr.

N68-29609# Westinghouse Electric Corp., Pittsburgh, Pa. Research Labs.
SUPERCONDUCTING BEHAVIOR OF SEMICONDUCTORS Final Report
J. K. Hulm and C. K. Jones 15 Apr. 1968 9 p refs
(Contract DA-31-124-ARO(D)-327)
(AROD-5171.5-P; AD-669247)

The purpose of this program has been to study the occurrence of superconductivity in systems wherein the density of conduction electrons may be varied over a wide range of values, such as degenerate semiconductors and semi-metals, and to attempt to relate the experimental results obtained in these investigations to available theoretical models based upon a knowledge of the normal state parameters of the materials. Author (TAB)

N68-29612 New Mexico State Univ., University Park.
ELECTRON SPIN RESONANCE OF MN ++ AND CU++ IONS IN MAGNESIUM ACETATE
Thomas Joseph Manakkil (Ph.D. Thesis) 1967 97 p
Available from Univ. Microfilms: HC $5.00/MF $3.00 Order No. 67-12852

The magnetic resonance absorption of manganese and copper ions in single crystals of magnesium acetate tetrahydrate is studied. The ions are diluted relative to the Mg++ ion in a ratio of about 1:100. The gross feature of the manganese spectrum shows an extensive fine structure and hyperfine structure corresponding to the first order transitions and a number of weak forbidden lines in the low field region. The optical absorption spectrum of the manganese complex is also investigated. The data show evidence of covalent bonding in the crystal. The unusually large crystal field splitting and the change of g factor with temperature are attributed to the combined action of crystal field and covalency effects. The group of forbidden lines are analyzed and compared to the normal spectrum. The copper resonance spectrum shows a well resolved hyperfine structure and at low temperature reveals an isotope splitting. The spin-lattice relaxation time for copper is estimated. Using magnetic resonance, covalent bonding parameters are calculated. The results show that the nature of bonding of the copper ion to the water molecules is appreciably covalent, while the bonding to the acetate groups is ionic. Dissert. Abstr.

N68-29667 Rensselaer Polytechnic Inst., Troy, N. Y.
CALCULATION OF A PHONON FREQUENCY IN SOLID SODIUM
Frederick Kenneth Bloom, Jr. (Ph.D. Thesis) 1968 117 p
Available from Univ. Microfilms: HC $5.80/MF $3.00 Order No. 67-4157

A phonon frequency in solid sodium at 5°K. is calculated for a phonon with wavevector $\vec{q}$. A one electron model has been used in which an electron interacts only with the ion in the same Wigner–Seitz cell. Direct electron–electron interactions are ignored. After solving the problem of an electron in a perfect lattice using the modified plane wave method, the lattice is perturbed as if by a phonon with wavevector $\vec{q}$. The resulting total change in energy of the system is found by perturbation theory and is used to calculate the phenon frequency $\omega_{\vec{q}}$. Dissert. Abstr.

N68-29676# Rutgers Univ., New Brunswick, N. J.
LONGITUDINAL ULTRASONIC ATTENUATION OF PURE STRONG-COUPLING SUPERCONDUCTORS 2
James W. F. Woo [1967] 9 p refs Sponsored in part by NSF
(AD-669498)

Previous work on low frequency longitudinal ultrasonic attenuation in pure strong-coupling superconductors is extended to all values of ql (l = electron mean free path, q = phonon wave number). The result differs from that obtained for impurity scattering because vertex corrections are unimportant in the present problem. Numerical calculations of the reduced attenuation were performed for various values of q. Author (TAB)

N68-29682 Florida State Univ., Tallahassee.
LUXEMBOURG EFFECT IN SILICON
Donald James Vincent Coleman, Jr. (Ph.D. Thesis) 1967 128 p
Available from Univ. Microfilms: HC $6.20/MF $3.00 Order No. 67-11153

The Luxembourg effect has been used to study electron heating in 170 ohm-cm silicon at 298°K. The electrons are heated by application of a high power x-band microwave pulse and the fractional change in conductivity sensed with a weak microwave signal. This method of investigating warm electrons allows one to use an easily prepared sample shape and eliminates electrical contacts to the crystal. Data analysis is performed using the thirteen moment approximation of Grad, assuming that the dominant electron scattering processes are acoustic phonon scattering and f-type intervalley scattering. Dissert. Abstr.

N68-29691 Stanford Univ., Calif.
CURRENT INSTABILITIES IN PIEZOELECTRIC SEMICONDUCTORS
William H. Haydl (Ph.D. Thesis) 1967 208 p
Available from Univ. Microfilms: HC $8.45/MF $3.00 Order No. 67-11036

Two instabilities may occur in piezoelectric semiconductors due to the interaction between acoustic waves and drifting carriers. Since both instabilities involve the amplification of acoustic energy, they appear only above fields at which the carriers drift faster than sound. The first instability causes a decrease in the sample current, which occurs within a time of the order of microseconds. This current saturation, as described and analyzed herein, is caused by the force a growing acoustic wave exerts on the carriers and the resultant change in the electric field distribution along the sample. Current saturation, we find, is observed at fairly low acoustic power densities. If higher acoustic power densities are approached, the second instability, which causes "current oscillations" and traveling high electric field domains, is observed. For the first time, potential probe measurements were made on CdS, resulting in the discovery of the traveling narrow regions of high electric field. A great portion of this report describes the discovery of squarewave type current oscillations and the traveling high electric field domains in cadmium sulfide. Numerous experiments were performed to determine the behavior of the traveling domain, the oscillation conditions and important parameters. Dissert. Abstr.

N68-29778# American Meteorological Society, Boston, Mass.
SEMICONDUCTING DIAMONDS PRODUCED BY ION BOMBARDMENT [POLUPROVODNIKOVYE ALMAZY, POLUCHENNYE METODOM IONNOI BOMBARDIROVKI]
V. S. Vavilov, M. I. Guseva, and E. A. Konorova Sep. 1966 7 p refs Transl. into ENGLISH from Fiz. Tverd. Tela (Leningrad), v. 8, no. 6, 1966 p 1964–1965
(Contract AF 19(628)-3880)
(T-R-632; AD-669189)

The present paper sets forth the results of an experiment in the alloying of natural diamonds with lithium and boron by ion bombardment. The diamonds were alloyed with an ion-beam apparatus with magnetic separation at a focusing angle of 180 degrees. The lithium and boron ions were injected into the natural face of the crystal or into the cleavage plane, either of which was perpendicular to the crystallographic directions (111) and (100). The energy of the ions was 40 KeV. Author (TAB)

N68-29794 Rice Univ., Houston, Tex.
FLUX SPOT INTERACTIONS IN SOLID CYLINDERS OF TYPE 1 SUPERCONDUCTORS
Michael Edward Melich (Ph.D. Thesis) 1967 77 p
Available from Univ. Microfilms: HC $4.20/MF $3.00 Order No. 67-13106

The Ginzburg–Landau free energy functional is used to investigate the interaction between two colinear normal regions containing flux within an infinite solid cylinder of type I superconductor. A model of the physical situation is used in constructing a vector potential which is representative of the trapped flux state. The dependence of the free energy on the relative size and separation of the flux spots is presented. The result indicates that there is a stable separation distance of the flux spots which depends upon the amount of trapped flux. When the spots are widely separated they have an attractive interaction between them while for the situation when they nearly overlap they strongly repel. The apparent hard core region is modified when the order parameter is allowed to vary. Dissert. Abstr.

N68-29797 Rice Univ., Houston, Tex.
AN IDEALIZED MODEL FOR THE BAND THEORY OF FERROMAGNETISM
Ching-tsung Lee (Ph.D. Thesis) 1967 72 p
Available from Univ. Microfilms: HC $4.00/MF $3.00 Order No. 67-13097

The object of this paper is to demonstrate by means of an idealized model that ferromagnetism, at least in the transition metals, can be understood to be associated with a narrow band of partly occupied energy levels combined with an adequately large additional interelectron interaction. The theory of the permutation group permits the classification of the electron states according to the total spin angular momentum S, in addition to the component S_z along a particular direction. The quantity computed is then the statistical mean value of S as a function of temperature. It can be shown quite clearly that when the interelectron interaction dominates the band energy, the system is ferromagnetic, i.e., it has a value of S approaching the maximum possible for the number of electrons involved, as T approaches zero. With the same values of the band energy and the interaction energy, it can be shown that statistical mean value of S/N of the order of $1/N^{1/2}$ as T approaches infinity. Furthermore, a rough estimate of the partition function shows a transition between the ferromagnetic and the non-magnetic state which has the general character of the observed behavior near the Curie temperature, and somewhat similar to that indicated by the molecular interaction theories. Dissert. Abstr.

N68-29826# Chicago Univ., Ill. Dept. of Chemistry.
A STUDY OF THE INTERACTIONS BETWEEN IONS IN SOLIDS Final Report, 1 Jul. 1964–31 Dec. 1967
Donald S. McClure May 1968 49 p refs
(Contract Nonr-2121(28))
(AD-669502)

The final report includes a review of work accomplished, a list of publications, a list of all personnel, copies of two technical reports, namely Optical Spectra of Divalent Mn(++) Salts: II. The effect of Interionic Coupling on Absorption Strength, by L. L. Lohr and D. S. McClure and The Electronic Absorption Spectrum of Ce(++) in CaF2 and the Energy Levels of the fd Configuration in a Cubic Field by J. P. Brown and D. S. McClure. Also included is an abstract of a paper The Jahn-Teller Effect of V(+++) in Al2O3 by P. J. Stephens and M. Lowe-Pariseau. Author (TAB)

N68-29828 Arkansas Univ., Little Rock.
ENERGY STORAGE AND EXTRACTION WITH SUPERCONDUCTING COILS
Melvin Keith Anderson (Ph.D. Thesis) 1967 77 p
Available from Univ. Microfilms: HC $4.20/MF $3.00 Order No. 67-12859

The storage and release of electrical energy from inductive storage systems using superconductors are studied. Inductors are known to have advantages over capacitors in every respect except ease of switching and the important property of storing the energy without appreciable loss. In the work described, it is shown that that energy can be retained in the inductive storage system with low losses providing the conductor is operating in the superconducting state. The use of a second winding to alter the time constant of the energy release is analyzed, along with the effect of a coefficient of coupling of less than one on the efficiency of the system and the switching transients involved. The use of a capacitor to aid in the switching and to reduce the transients is investigated as is the effect of an initial charge on the capacitor. Various types of superconducting switches are investigated and a switch using the transition characteristics of a superconductor was developed having a current carrying capacity of approximately 30 amps and a switching time of less than 100 microseconds. Dissert. Abstr

N68-29833 Iowa State Univ. of Science and Technology, Ames.
FIELD MODULATION STUDIES OF THE DE HAAS-VAN ALPHEN EFFECT IN NICKEL
Dennis Ray Stone (Ph.D. Thesis) 1967 135 p
Available from Univ. Microfilms: HC $6.40/MF $3.00 Order No. 67-13003

We have studied the de Haas–van Alphen effect in spherical nickel crystals in fields up to 63 kOe and at temperatures as low as

1.1°K using a low frequency (~40 Hz) field modulation technique. Our measurements showed that the field modulation technique could be used for ferromagnetic samples provided that the modulation frequency was less than 25 kHz and that the modulation field was parallel to the applied field direction. The observed de Haas–van Alphen oscillations are interpreted as arising from two distinct sheets of Fermi surface: one, a multiply connected copper-like sheet centered at the point Γ in the zone and the other a set of equivalent fluted ellipsoids situated at the symmetry points X in the zone. We have interpreted these surfaces in terms of the band structure predicted by L. Hodges and have shown that our measurements are in complete accord with these new calculations.
Dissert. Abstr.

N68-29878 Stanford Univ., Calif.
A THEORETICAL INVESTIGATION OF DISLOCATION DISTRIBUTIONS IN TWO-PHASE SYSTEMS
David Morton Barnett (Ph.D. Thesis) 1967 212 p
Available from Univ. Microfilms: HC $9.70/MF $3.00 Order No. 67-11015

The interactions between dispersed second phase particles or inclusions and slip dislocations exert a large influence upon the strength and ductility of crystalline solids. An important example of such interactions may be represented by a planar array of slip dislocations which has been blocked by, and thus has piled up against, the second phase. The present study is an examination of the effects of second phase size and rigidity upon the stresses associated with such blocked dislocation arrays. Using the method of continuously distributed dislocations, exact analytical solutions are obtained for the stress fields associated with: (1) a screw dislocation pileup at a rigid circular inclusion; (2) a screw dislocation pileup at a semi-infinite second phase of finite rigidity, (3) a screw dislocation pileup at a circular inclusion of finite rigidity. An exact solution for the stresses generated by an infinite sequence of parallel screw dislocations piled up against an elastic half-plane of finite rigidity is also presented.
Dissert. Abstr.

N68-29905 West Virginia Univ., Morgantown.
MAGNETOSTRICTIVE BEHAVIOR OF IRON SINGLE CRYSTALS
George Machir Williams (Ph.D. Thesis) 1967 145 p
Available from Univ. Microfilms: HC $6.80/MF $3.00 Order No. 67-11803

The magnetostriction of iron single crystals has been measured as a function of temperature (77°K to 897°K) and magnetic field. This data has been used to evaluate the magnetostriction constants for two constant and five constant phenomenological expressions. The anomalous behavior of the constant λ 100 near the Curie temperature is confirmed. The forced magnetostriction constants have also been evaluated.
Dissert. Abstr.

N68-29906 Syracuse Univ., N. Y.
AN EXPERIMENTAL INVESTIGATION OF THE ELECTRONIC ENERGY BAND STRUCTURE OF VANADIUM-IRON ALLOYS
Michael John Yessik (Ph.D. Thesis) 1967 82 p
Available from Univ. Microfilms: HC $4.40/MF $3.00 Order No. 67-12092

An investigation of the electronic energy band structure of vanadium-iron alloys with 8 to 45 atomic % iron is made by means of measurements of the specific heat, enthalpy, resistivity, and thermoelectric power. The specific heat is measured from 125–625°K in an adiabatic calorimeter. A similar analysis of enthalpy measurements made on these alloys from 800 to 1200°K yields γ values which agree with the liquid helium temperature results for all alloy compositions. Resistivity measurements are made on these same specimens from 100–600°K. These results are analyzed according to a model which says that electrons are the predominant current carriers and scattering of electrons is mainly by means of s-d transitions. Thermoelectric power measurements are made on these same specimens from 100–600°K. These results also give good agreement with this density of states curve.
Dissert. Abstr.

N68-29929 Pittsburgh Univ., Pa.
STRUCTURAL AND MAGNETIC PROPERTIES OF $TiCr_2$, $ZrCr_2$, $HfCr_2$ AND THE YFe_2–YCo_2 AND $TiCo_2$–$ZrCo_2$ ALLOY SYSTEMS
Alan Wilson Abel (Ph.D. Thesis) 1967 85 p
Available from Univ. Microfilms: HC $4.40/MF $3.00 Order No. 67-12585

Structural and magnetic properties of the polymorphic chromium Laves phases $TiCr_2$, $ZrCr_2$, $HfCr_2$, and the pseudo-binary Laves phase systems YFe_2–YCo_2 and $TiCo_2$–$ZrCo_2$ were investigated. Samples were prepared by induction melting, and their crystal structures examined by powder X-ray diffraction. Magnetic susceptibilities were determined by the Faraday method. Eleven samples in the YFe_2–YCo_2 system were prepared. The system was found to be single phase, cubic ($MgCu_2$) throughout, with the lattice parameters obeying Veygard's rule over the entire range of composition. All samples were found to possess ferromagnetic alignment; Curie points were too high to be obtained. In the $TiCo_2$–$ZrCo_2$ system, eleven samples were prepared. This system was also found to be single phase cubic ($MgCu_2$), throughout, with the lattice parameters obeying Veygard's rule. Lattice parameters and values of the appropriate magnetic quantities as functions of temperature and field strength are reported for each sample in all systems. Saturation moments are reported for each sample in the $YFe_2$2–YCo_2 system.
Dissert. Abstr.

N68-29938# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MOESSBAUER EFFECT IN STUDYING LATTICE VIBRATION
Kai-i Chang 25 Aug. 1967 7 p refs Transl. into ENGLISH from Wu Li Hsueh Pao (Peking), v. 20, no. 5, 1964 p 477–478
(FTD-HT-66-502; AD-669541)

The possibility exists of using the Mossbauer effect to determine experimentally frequency diagrams of crystal lattices that are not of the Debye type. Thus a formula is proposed for determining the lattice frequency diagram using the relationship between the Mossbauer recoilless transition probability and temperature. The formula is applicable to a single-atom cubic lattice.
TAB

N68-29956*# Scripta Technica, Inc., Washington, D. C.
MOSSBAUER Co 57 SOURCE INCORPORATED INTO PALLADIUM [MESSBAUEROVSKIY ISTOCHNIK CO 57 V PALLADII]
D. Dobrev, T. Tomov, T. Ruskov, and D. Lefterov NASA Jul. 1968 4 p refs Transl. into ENGLISH from Pribory i Tekhn. Eksperim. (Moscow), no. 5, 1967 p 235–237
(Contract NASw-1694)
(NASA-TT-F-11654) CFSTI: HC $3.00/MF $0.65 CSCL 20L

The procedure for producing a Mössbauer Co^{57} source incorporated in a palladium lattice is described. The electrolytic deposition of Co^{57} onto palladium foil, as well as its introduction into the palladium matrix are described. The line width referred to zero thickness of the absorbent $Na_2[Fe(CN)_5NO]\cdot 2H_2O$ is increased by only 10% in comparison to the natural width. On the basis of the obtained Mössbauer spectra for various thicknesses of the absorbent the authors calculated a Debye–Waller factor for the source, which turned out to be equal to 0.8.
Author

N68-29976 Oregon State Univ., Corvallis.
CORRELATIONS BETWEEN CRYSTAL ORIENTATION, DEFORMATION TEXTURE, AND INDENTATION ANISOTROPY IN TUNGSTEN AND MOLYBDENUM SINGLE CRYSTALS
Colin John Sandwith (Ph.D. Thesis) 1967 205 p
Available from Univ. Microfilms: HC $9.25/MF $3.00 Order No. 67-9692

The purpose of this thesis was to investigate the anisotropy of some mechanical properties of commercial tungsten single crystals which were grown by the arc-Verneuil process. The primary results of this study are as follows: (1) The symmetries shown by ridging around indentations, and the characteristic slip line patterns in the vicinity of indentations, have been related to the crystal symmetries of the indented planes. (2) A simple microscopic technique has been discovered for clearly revealing the ridging symmetry around indentations. (3) The ridging symmetry, which is caused by plastic anisotropy of the crystals, is qualitatively explained. (4) The indentation anisotropies of the (001), (110), (111), and (112) planes in tungsten single crystals, as revealed by the characteristic ridging around Rockwell A(R_A) hardness indentations, have been correlated with Knoop hardness number (KHN) anisotropies in the same planes. (5) Single crystal specimens of tungsten, 1/2-inch in diameter and 1/2-inch long, were forged parallel with the [001], [110], and [111] directions and the plastic anisotropy, as measured by radial strains, has been correlated with crystal symmetry and with the plastic anisotropy exhibited by KHN and R_A indentations. (6) The plastic anisotropy as revealed by R_A indentations has also been used to identify simple deformation sheet textures in heavily deformed tungsten and molybdenum. Dissert. Abstr.

N68-30004 Iowa State Univ. of Science and Technology, Ames.
AMPLITUDE STUDIES OF THE DE HAAS–VAN ALPHEN EFFECT IN LEAD
Russell Allan Phillips (Ph.D. Thesis) 1967 149 p
Available from Univ. Microfilms: HC $7.00/MF $3.00 Order No. 67-12987

A detailed study of the amplitudes of the de Haas–van Alphen (dHvA) effect in lead is presented. These experiments were performed in a high-field pulse magnet employing a resonant filtering system. As a prelude to this work, it was necessary to devise special techniques for the preparation of crystals of high perfection. Accurate effective mass values were measured for all the dHvA frequencies at symmetry directions. These mass studies refer not only to the fundamental terms but also to higher harmonics and combination tones. The results of the temperature-dependence of the harmonic and combination amplitudes indicate that magnetic-interaction effects must be considered. Extensive studies of the magnetic-field dependence of the dHvA amplitudes were also made. The results of these measurements show that the Landau levels in pure lead crystals of high perfection are indeed very sharp. Dissert. Abstr.

N68-30009 Arizona Univ., Tucson.
EXTENSION OF THE THEORY OF UNIJUNCTION TRANSISTORS
John Scott Linder (Ph.D. Thesis) 1967 133 p
Available from Univ. Microfilms: HC $6.40/MF $3.00 Order No. 67-11966

The unijunction transistor is a three terminal semiconductor device possessing only a single p-n junction. The purpose of this work was to investigate general treatments of the unijunction transistor. It consists of extensions of the Scharfetter–Jordan theory for the effects of conductivity modulation on the static emitter characteristics, some generalized characterizations of unijunction transistors, and studies of the large signal behavior of a particular unijunction transistor multivibrator. The theory of Scharfetter and Jordan for unijunction transistors is considered and a more general treatment of a near intrinsic filament is developed. Static emitter characteristics, including the effects of drift, diffusion, and recombination on carrier transport, are predicted. The generalized characterization of unijunction transistor networks is considered. The general formulation is considered from the viewpoint of a unijunction transistor embedded in a network of linear elements and concerns itself with, among other things, the determination of a minimum set of device characteristics needed for an exact analysis. The large signal behavior of a particular unijunction transistor multivibrator is considered. General stability conditions for astable, monostable and bistable operation are formulated as well as analytical predictions of turn-on and turn-off transients and cycle durations. Dissert. Abstr.

N68-30028*# Auburn Univ., Ala. Dept. of Physics.
INVESTIGATION OF ELECTRICAL CONDUCTIVITY IN AMORPHOUS SEMICONDUCTORS Final Report
A. T. Fromhold, Jr. 15 Dec. 1967 252 p refs
(Grant NGR-01-003-012)
(NASA-CR-95837) CFSTI: HC $3.00/MF $0.65 CSCL 20L

A theoretical and numerical study of several models for the thermal oxidation of metals is presented. Fromhold's coupled current approach is used, with diffusion in discrete lattices assumed for ion transport and thermal emission, and quantum mechanical tunneling assumed for electron transport. The field-assisted diffusion equation is derived, emphasizing lattice discreteness. The discrete formulation for negligible space charge yields a very simple result and illustrates the advantages of that approach. The complexities of diffusion in the presence of space charge prevent a complete analytical solution of that case, but complexity is reduced and a formulation amenable to numerical study is derived. The equations for the metal-oxide-oxygen system are discussed. Expressions developed for electron and ion transports contain the capability of current equilibria during oxidation. A numerical model study of ion diffusion and electron tunneling shows virtual electron current equilibrium in the early growth phases, with growth rate limited by diffusion. In later growth phases a virtual ion current equilibrium exists, with growth rate limited by electron tunneling. The transition between these two extreme conditions is examined. Growth kinetics under virtual electron and ion current equilibria are analytically formulated and tabulated. The virtual current equilibria of the oxidation model based on ion diffusion and thermal emission are also analyzed. K.W.

N68-30052# Centre d'Etude et de Recherches en Technologie Spatiale, Toulouse (France).
ON THE PROBLEM OF TIME EQUIVALENCE OF IRRADIATION [PROBLEME DE L'EQUIVALENCE EN TEMPS D'UNE IRRADIATION]
A. Roizes May 1968 16 p refs In FRENCH
(CERTS-NT-02-3) CFSTI: HC $3.00/MF $0.65

The distribution of defect centers in crystals depends not only on impurities, but also on thermal cycle and energy of the radiation. Different factors that can influence the defect center distribution are analyzed in the temperature range −100°C to +100°C. It is shown that with better knowledge of the recovery process it would be possible to simulate long irradiation times with reasonable operation time of a particle accelerator. ESRO

N68-30057# McDonnell-Douglas Co., Santa Monica, Calif. Missile and Space Systems Div.
IMPURITY DISTRIBUTION IN MAGNESIUM OXIDE CRYSTALS BY MICROAUTORADIOGRAPHY
S. K. Asunmaa and N. A. Tiner Sep. 1967 26 p refs Presented at the 20th Pacific Coast Am. Ceram. Soc. Regional Meeting, San Francisco, 1–4 Nov. 1967
(Douglas Paper-4740)

A nondestructive microautoradiography method, with high sensitivity and high resolving power, is applied to studying elemental microdistribution of impurities in magnesium oxide crystals. A critical preevaluation of the nuclide characteristics, half lives, relative concentrations, and induced activities indicated that thermal neutron irradiation for inducing the (nγ) reactions should be used for the distribution analysis of the iron and calcium impurities. Reaction conditions and the nuclear characteristics of the (n,γ) reaction products in the multicomponent system are listed. The technique also involves deposition of a combined surface replica and recording film on the sample surface for proper exposure to a contact autoradiograph, which records radioactivity centers in the specimen surface layer; and examination of the replica–autoradiograph sandwich under a electron microscope for correlating radioactivity distribution to surface detail, and for simultaneous semiquantitative activity analysis. Observation of the distribution patterns suggest that the ion electronic properties may influence the impurity distribution in crystals. M.G.J.

N68-30088 IIT Research Inst., Chicago, Ill.
A SELF-CONSISTENT SEMI-CONTINUUM F-CENTER CALCULATION FOR BOTH ABSORPTION AND EMISSION
Robert Lionel Gilbert (Ph.D. Thesis) 1967 226 p
Available from Univ. Microfilms: HC $10.35/MF $3.00 Order No. 67-9184

The luminescence processes associated with F-centers were studied using a semi-continuum model. The major interaction leading to the marked Stokes' shift exhibited is due to the electrostatic interaction between the F-electron and the neighboring ions. The Stokes' shift was caused by the change in the electrostatic interaction between the F-electron and the neighboring ions during post-excitation relaxation. The following were derived for NaCl and KCl: (1) self-consistent potentials for the absorption and emission processes; (2) energy level diagrams for the F-electron relative to the bottom of the conduction band for both the absorption and emission processes; (3) self-consistent values for the displacements of the first nearest neighbors; and (4) wave functions for the F-electron consistent with the potentials during both absorption and emission. Loose binding is manifested during emission, tight binding during absorption. The wave functions for the emission process are the first published that have been derived in a self-consistent manner appropriate for the loose binding approximation. Dissert. Abstr.

N68-30102# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ABOUT MEASUREMENTS OF SMALL SERVICE LINES BY FREQUENCY-PHASE CHARACTERISTIC OF IMPEDANCE OF P-N TRANSITION [OB IZMERENII MALYKH VREMEN ZHIZNI PO CHASTOTNO-FAZOVOI KHARAKTERISTIKE IMPEDANSA P-N PEREKHODA]
E. I. Adirovich, O. Ya. Kruchenetskiy, O. M. Kurbanov, and S. P. Lunezhev 1 May 1967 9 p refs Transl. into ENGLISH from Dokl. Akad. Nauk Uz. SSR (Tashkent), no. 10, 1964 p 11–14
(FTD-HT-66-608; AD-670123)

A theoretical basis and experimental proof is given for the possibility of using the phase shift between the voltage across a diode and the current through it to measure short lifetimes in semiconductors. In contrast to previously developed methods, this method does not require establishment of limiting operating conditions for the diode (conditions for the current or voltage generator). The method facilitates the measurement of lifetimes less than 10-9 sec. An experimental check of the method is made on an electrical analog of a diode. Author (TAB)

N68-30130 Kansas Univ., Kansas City.
SEVERAL PROBLEMS DEMONSTRATING THE EFFECTS OF COUPLE-STRESSES AND A LATTICE ANALOGY
Charles Burton Banks, Jr. (Ph.D. Thesis) 1966 98 p
Available from Univ. Microfilms: HC $5.00/MF $3.00 Order No. 67-10797

The development of an analogy between the couple–stress type of continuum and a discrete lattice structure are presented. Since the elastic constants in the two media are not related in the same manner the analogy is not completely achieved, however, it does point out the possibility of practical applications for the couple–stress theory and suggests an alternate approach for experimental verification. The problem of a semi-infinite plate loaded along one boundary is also discussed. First, the general form of the solution is established and then a more detailed study is made of the particular cases when the applied load is either a single concentrated force or a single concentrated moment. The most important conclusions drawn from these problems are that a significant decrease occurs in the stress concentration factor (sometimes as much as 50%); and that the effect of couple–stresses is restricted to the immediate vicinity of the point of application of the load. Dissert. Abstr.

N68-30148# Monsanto Research Corp., Everett, Mass. Boston Lab.
PURITY-PROPERTY RELATIONSHIPS IN ORGANIC SEMICONDUCTION Final Report, 15 Sep. 1966–14 Sep. 1967
John S. Driscoll, Stephen C. Kwan, and Abraham W. Berger Apr. 1968 116 p refs
(Contract AF 19(628)-4348)
(MRB2031F; AFCRL-68-0181; AD-669352)

The removal of naturally occurring impurities from oxazole scintillators reduced both the dark and photoconductivity. The addition of charge-transfer acceptors (e.g. chloranil) reduced the Ip/Id ratio in the host at concentrations as low as 0.00001 mole fraction. Impurities reduced both Ip/Id and solid state fluorescance values. Sodium salicylate and 1,3,4,7-tetraphenylisobenzofuran were also studied. The dark conductivities of the cyanine (photosensitizing) dyes showed a decrease in activation energy with increasing molecular conjugation. Flash photolysis was investigated as an analytical tool. Triplet state absorption in anthracene was absent when highly purified reagents were used. Author (TAB)

N68-30196*# General Dynamics/Pomona, Calif.
ELECTRON MICROSCOPE STUDY OF FILM NUCLEATION
E. P. Meagher Jul. 1968 27 p refs
(Contract NAS12-611)
(NASA-CR-86084; TM-6-349-260) CFSTI: HC $3.00/MF $0.65 CSCL 20L

Nucleation and growth of iron and vanadium thin films were observed inside an electron microscope to identify a possible body centered cubic (bcc) to face centered cubic (fcc) polymorphic transformation as a function of deposited mass per unit area. A summary description of the experimental setup is given. The resulting in-situ iron depositions at room temperature, 500°C and −50°C all produced iron oxide. In one case a bcc iron structure was observed along with iron oxide. In-situ vanadium depositions resulted in both vanadium oxide and in some instances a bcc structure. No evidence was established indicating the presence of a fcc phase in the film growths. Whenever a pure metal phase could be identified, it had bcc structure. The failure to observe an fcc phase could be laid to presence of oxides. The experiment indicated that the ratio of incident metal particle flux to background pressure governs the presence of a pure metal phase in early film growth stages. D.H.B.

N68-30311*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
A CONTACT RULE FOR RIGID-SPHERE MODELS OF CRYSTAL STRUCTURES

Paul J. Shlichta 1 Aug. 1968 17 p refs
(Contract NAS7-100)
(NASA-CR-95877; JPL-TR-32-1299) CFSTI: HC $3.00/MF $0.65
CSCL 20B

If a crystal structure is regarded as a space-group array of rigid spheres in contact, then the relationship F=P−C+1 holds, where P is the number of dimensionless variable parameters of the structure and F is the number of degrees of freedom in parameter-space when C modes of contact are present. This contact rule is, like Gibbs' phase rule, a simultaneous-equation rule and permits the construction of contact diagrams that show how atomic contacts change as the structural parameters are varied. These diagrams provide a convenient means of calculating and displaying the parametric variation of such properties as connectivity, coordination number, packing fraction, and the Madelung constant. To the extent that atomic radii and bond type are physically meaningful concepts, the contact rule is also useful for optimizing atomic position parameters in trial structures, comparing the bonding properties of different structures, deriving consistent values for atomic radii, and characterizing bond type. Author

N68-30333# Sperry Microwave Electronics Co., Clearwater, Fla.
LOW MAGNETIC SATURATION GARNETS Final Report, 1 Nov. 1967–31 Jan. 1968
L. R. Hodges, Jr., G. P. Rodrigue, G. R. Harrison, and W. R. Wilson May 1968 132 p
(Contract DAAB-07-67-C-0142)
(SJ-220-4526-4; ECOM-0142-F; TR-4; AD-670023)

Methods were derived for reproducible synthesis of both mono- and polycrystalline Y and BiCaV type garnets with 4(pi)Ms in the 100 to 900 gauss range. A full characterization of the magnetic and microwave properties of these newly developed compositions, indicates promise for use in microwave circulator and phaser applications. It was found that some of the new compositions offer the following advantages over standard YIG type materials: (1) lower material cost for the BiCaVIG type compositions, (2) improved compositional stability and anisotropy fields (as low as 16 oersteds) for Ga substituted YCaVIG single crystals, (3) improved temperature stability of 4(pi)Ms and linewidth, and lower magnetostriction effects in polycrystalline compositions, (4) uniquely low polycrystalline linewidths down to ~60C at L band for In substituted YCaVIG. Preliminary tests of the newly developed materials in an L band microstrip circulator and S band high power digital phase shifter is described. A thorough evaluation of selected compositions was made in a below resonance Y-junction circulator operating in the 2.0 GHz range. Author (TAB)

N68-30342# Atomic Energy Board, Pretoria (South Africa).
ZERO SOUND AND SUPERCONDUCTIVITY AS PROTOTYPE OF THE MANY-BODY PROBLEM
P. du T. van der Merwe Aug. 1967 58 p refs
(PEL-159)

An account is given of the modern theory of superconductivity starting from the microscopic interactions between the conduction electrons and phonons. The properties of a many-particle Fermi system are studied at low temperatures. The physical basis of the theory of superconductivity is discussed, and a quantum mechanical treatment of the superconducting phase is given. The theory of the Fermi liquid at absolute zero is presented on the basis of Schwinger techniques. The method of structure analysis is introduced into the regime of the many-body problem. A new derivation of the Cooper phenomenon is given. The Green's function theory of superconductivity is developed at finite temperatures. Some of the recent developments such as the breakdown of the quasi-particle approximation, the Ginzburg–Landau equation, and Abrikosov flux lines, are mentioned. Analogies between the many-body problem and particle physics are discussed. NSA

N68-30351# Texas Instruments, Inc., Dallas.
DEFECTS AND THEIR ROLE IN DETERMINING BULK PROPERTIES OF CRYSTALS
William C. Holton May 1968 19 p refs
(Contract F44620-67-C-0073)
(AFOSR-68-0956; AD-669814)

Most impurities in II-VI compounds play a role in luminescence either because they are the luminescence center, or they are photosensitive (i.e., they exist in several charge states), or they function as a non-radiative recombination center. Since many of these centers are stable in more than one charge state, prepared by optical excitation at low temperature, the atomic structure of the centers may be deduced from observation of their paramagnetic resonance. Associated optical studies then correlate the paramagnetic center with the luminescence process and excited state structure. This was done for the transition metal, rare earth, and Groups I, III, V, and VII impurity ions. The existence of associates, the occurrence of the Jahn-Teller effect, and resonant energy transfer are among the important phenomena studied. Self-activated luminescence centers have been studied in ZnSe and ZnS; Cu(3d(9)) impurity ions have been studied in ZnSe and ZnS, where optical Zeeman effect measurements have observed the CuZn in Td symmetry. The Jahn-Teller effect of Sc(3d(1)) has been studied in detail in CaF2 and SrF2. Rare earth 3(+) and 2(+) ions were observed in all of the II-VI compounds; associates of the (rare earth)(3+) ion with (noble metal)(+) impurities are observed, and transition metal associates are likewise seen. Finally, luminescence associated with Group V impurities, and population inversion of optically pumped (2)S 1/2 state impurity ions have been discovered. Author (TAB)

N68-30354 Arizona State Univ., Tempe.
THE CRYSTAL STRUCTURE OF [BIS(2-AMMONIUMETHYL) AMMONIUM CHLORIDE][TETRACHLOROCUPRATE(II)]
Gary Loren Ferguson (Ph.D. Thesis) 1967 84 p
Available from Univ. Microfilms: HC $4.40/MF $3.00 Order No. 67-12642

The crystal structure of $[NH_3 - (CH_2)_2 - NH_2Cl - (CH_2)_2 - NH_3][CuCl_4]$, AEA, has been determined by single-crystal X-ray diffraction methods. Filtered Mo Kα radiation was used, and intensities were rated visually. The experimental density was found to be 1.837 g./ml. Each copper atom is surrounded by four chlorine atoms at a distance of 2.28Å and two chlorine atoms at 2.88Å. Each end nitrogen atom of the organic chain is surrounded by eight chlorine atoms at distances ranging from 3.19–4.16Å, giving rise to an overall chlorine to nitrogen packing ratio of 12:2. The central nitrogen atom of the organic chain is hydrogen bonded to a chlorine atom on the mirror plane located at y=0.25. The unit cell was found to be orthorhombic with a=7.15±0.03Å, b=23.70±0.08Å, and c=7.36±0.03Å. The distribution of intensities on the (hOl) and (hkO) nets at 119°C. was essentially identical to the distribution of intensities at room temperature. The thermochromism observed at high temperatures can be accounted for in terms of N-H interactions with the antibonding orbitals of the tetrachlorocuprate(II) ion. Dissert. Abstr.

N68-30427# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
PREPARATION AND OPTICAL PROPERTIES OF EPITAXIAL THIN FILMS OF SOME 2–4 SEMICONDUCTING COMPOUNDS
Rudolf Ludeke Apr. 1968 248 p refs
(Contract N00014-67-A-0298-0012)
(HP-22; AD-670084)

The work describes mainly the preparation and optical properties of epitaxial thin films of some II-IV semiconducting compounds. In addition optical modulation experiments on both thin film and bulk samples are reported. Epitaxial thin films of CdTe, HgTe, the alloy system CdxHg1-xTe, and CdSe were prepared by

a flash evaporation technique on BaF2 substrates. The effects of various deposition parameters on the electron diffraction and optical structures of CdTe and CdSe were analyzed in detail. Optical transmission measurements on the epitaxial thin films were made at room and liquid nitrogen temperatures in the spectral region from 2 to 6 eV. Two novel approaches of optical modulation methods were pursued: piezo-transmission on Ge and CdTe polycrystalline films and electroreflectivity on bulk CdTe using an integral sandwich technique. Both methods were used down to liquid helium temperatures. TAB

N68-30481# Eidgenossische Technische Hochschule, Zurich (Switzerland).
STATIONARY TRANSPORT PHENOMENA IN INHOMOGENEOUS SEMICONDUCTORS [STATIONARE TRANSPORTVORGANGE IN INHOMOGENEN HALBLEITERN]
Manuel Sanchez Garcia (Ph.D. Thesis) 1967 108 p refs In GERMAN
(Diss. Nr. 4030) CFSTI: HC$3.00/MF$0.65

In this work an attempt is made to formulate some rigorous statements concerning the theory of the transport phenomena in semiconductor devices. Beyond that, exact computer calculations are performed in order to clarify several essential questions of this theory. The first chapter contains the derivation of the expressions for the current density and the energy flux from Boltzmann equation in inhomogeneous covalent isotropic semiconductors. The expressions obtained hold for hot and cold carriers with arbitrary distribution functions. The mobility of hot electrons and holes in germanium at 300°K is calculated as a function of the carrier temperature and electric field. In the third chapter an additional case of the general boundary-value problem is investigated. The forward steady-state behavior of a one-dimensional abrupt p-n junction germanium diode at zero and at low to high injection levels at 300°K is considered. The numerical results for the hole and electron concentration distributions, the electric field distributions, the electron current density distributions, the electrostatic potential distributions and the space-charge density distributions are reported for five values of the total current density across the p-n junction. The computer program used for this calculation is fully described in an appendix. Author

N68-30552# Brookhaven National Lab., Upton, N. Y.
INTERATOMIC POTENTIALS FOR POINT DEFECT CALCULATIONS FOR NIOBIUM, MOLYBDENUM, TANTALUM, AND TUNGSTEN
R. A. Johnson [1967] 11 p refs Presented at the NATO Evaluation Conf. on High Temp. Mater., Sandefjord, Norway, 31 Jul.–5 Aug. 1967 Sponsored by AEC
(BNL-11594; CONF-670718-1) CFSTI: HC$3.00/MF$0.65

Interatomic potentials can be found for use in model calculations for defect properties of the refractory metals, Nb, Mo, Ta, and W, although it is difficult to obtain unique results. For each metal, several calculations for better-known defect properties would have to be carried out with a variety of potentials to determine which one gives the most realistic values. Then these potentials could be used for further calculations. The potentials are not as "smooth" as the α-Fe interaction used in earlier calculations. They show a tendency towards requiring a local maximum between first and second neighbor distances. This effect is more pronounced for Nb and Ta than in Mo and W. There is also a tendency for the well depth to be greater at the second neighbor distance than at the first. Author (NSA)

N68-30592*# General Dynamics/Pomona, Calif.
ELECTRON MICROSCOPE STUDY OF FILM NUCLEATION
K. J. Kronenberg Feb. 1968 47 p refs
(Contract NAS12-560)
(NASA-CR-86083; TM-6-349-247) CFSTI: HC $3.00/MF $0.65
CSCL 20L

The formation of thin metal films has been observed by electron diffraction and electron microscopy during in-situ deposition on amorphous carbon films. Specifically, the formation of deposits of iron, copper and gold has been investigated at various temperatures for transformations of crystal structure, variations of atomic distances and phase changes. The existence of crystallites with diameters of less than 20 Å was deduced from electron diffraction rings only. Particles with dimensions larger than 20 Å were observed directly. Structural transformations of the crystal lattice were only observed in deposits of iron. Unit cell dimensions in both types of iron crystals seemed to be largest in very small particles and decreased during the growth of crystallites. Copper and gold deposits started observable nucleation with an f.c.c. type lattice structure. The early deposits grew without any noticeable transformation in structure. All deposits with dimensions of more than 80 Å showed well defined crystallization while diffraction patterns and images of smaller deposits indicated incomplete crystallization. No "liquid" phase was found at any stage of the metal deposits. Author

N68-30648# California Univ., Livermore. Lawrence Radiation Lab.
ALTERNATING CURRENT LOSS MEASUREMENTS IN SUPERCONDUCTING MAGNETS
William S. Gilbert, Roland E. Hintz, and Ferd Voelker Apr. 1968 24 p refs
(Contract W-7405-ENG-48)
(UCRL-18176) CFSTI: HC$3.00/MF$0.65

Measurements have been made of energy lost in charging and discharging superconducting magnets containing NbTi material. An electrical multiplier technique has been developed for measuring these losses. Single cycle losses can be determined with this method. Loss data have been obtained for peak magnetic fields ranging from a few kilogauss to 70 kilogauss. These measured losses are compared with theory. A new ordering effect, in which the cyclic loss depends on the previous magnetic history of the superconductor, has been found. Author (NSA)

N68-30823#
INVESTIGATION OF SOME PROPERTIES OF SILVER ANTIMONY SULFIDE
M. I. Butsko 1968 4 p refs Transl. into ENGLISH from Ukr. Fiz. Zh. (Kiev), v. 9, no. 6, 1967 p 686–688
CFSTI: HC$3.00/MF$0.65

A study focusing on the determination of the electrical and photoelectrical properties of pure, synthetically fabricated samples of Ag_3SbS_3 is reported. Discussed are techniques used to produce polycrystalline pyrargyrit (silver antimony sulfide) samples; physical properties of Ag_3SbS_3 crystals; and polarization effects in samples under the effect of an applied voltage. S.C.W.

N68-30836# Aerospace Corp., El Segundo, Calif. Lab. Operation.
RELAXATION OSCILLATIONS IN JOSEPHSON JUNCTIONS
Frank L. Vernon, Jr. and R. J. Pedersen Feb. 1968 21 p refs
(Contract F04695-67-C-0158)
(TR-0158(9230-01)-2; SAMSO-TR-68-149; AD-670157)

Investigation of the characteristics of Josephson tunneling in tin/tin oxide/tin junctions showed that pulse voltages with sharp rise times were being generated. Pulse amplitude across the junction remained constant and equal to the energy gap voltage V sug g, but pulse frequency could be changed over a 25:1 range by a change in bias voltage from 0 to an upper limit approximately equal to v sub g/2. The oscillation mechanism is that of switching between the pair-current state of the junction at V = 0 and the quasi-particle current state at V = V sub g. The external circuit maintains the switching cycle and determines the output frequency characteristics. Using the L/R time constant of the external circuit and the assumed basic DC I(V) curve of the junction in the absence

of relaxation oscillations, calculations were made that accurately describe the observed DC I(V) curves, frequency, and waveforms, including their dependence on bias voltage and magnetic field. Author (TAB)

N68-30838# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MODERN STATUS AND PROSPECTIVE TECHNICAL APPLICATION OF THE SUPERCONDUCTIVITY PHENOMENON [SOVREMENNOYE SOSTOYANIYE I PERSPEKTIVY TEKHNICHESKOGO ISPOL'ZOVANIYA YAVLENIYA SVERKHPROVODIMOSTI]
V. V. Sychev 14 Sep. 1967 19 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Energ. i Transp. (Moscow), no. 4, 1966 p 26–32
(FTD-MT-67-20; AD-670255)

The author reviews the rapid growth of knowledge and use of superconductors especially in the fields of nuclear reaction, space research, radio electronics and computer technology. The possible use of a superconductor system to provide protection of space ships and crews against cosmic radiation is suggested. Major attention is devoted to the future possibilities of using superconductors in power engineering in connection with magnetohydrodynamic generator systems. Author (TAB)

N68-30846# Aerospace Corp., El Segundo, Calif. Lab. Operations.
HABIT CHANGES AND GROWTH MECHANISMS OF IN203 GROWN FROM PBO-B203 MELTS
Armond B. Chase Feb. 1968 28 p refs
(Contract F04695-67-C-0158)
(TR-1058/9230-03/2; SAMSO-TR-68-162; AD-670160)

Crystals of In2O3 grown from a PbO-B2O3 melt show habit changes and imperfections that appear to be related to the growth mechanisms and to the relative supersaturations in the melt. The crystals show surface features indicative of growth by two-dimensional corner and edge nucleation followed by growth spirals due to screw dislocations. Striations and trapped flux occurred in the crystals when the crystals grew by corner and edge nucleation. The frequency of the striations decreased when the primary growth mechanism changed from edge nucleation to a screw-dislocation mechanism. Author (TAB)

N68-30849# Boston Univ., Mass.
DELAYED COINCIDENCE-MOSSBAUER STUDIES OF SOLID STATE PHENOMENA Final Report, 1 Apr. 1966–30 Apr. 1968
Gilbert R. Hoy 17 May 1968 7 p refs
(Grant DA-ARO(D)-31-124-G808)
(AROD-6338.10-P; AD-669631)

The research group has developed a suitable system for performing delayed-coincidence Mossbauer studies of solid state phenomena. The essential feature of effective electric field gradients and magnetic fields in ferrous compounds has been the development of techniques for obtaining the values of the effective fields at iron nuclei in solids from the corresponding Mossbauer spectrum. It was shown that a measurement of the discontinuity in the electric field gradient at the iron nuclei as a function of temperature is closely related to the ferroelectric transition. The effective field parameters at Fe57 nuclei in the cubic normal spinel FeCr2S4 have been investigated in the temperature range from 80 degrees K to 298 degrees K, using the Mossbauer effect. Single crystals of sodium nitroprusside were grown from solution and cut in various orientations with respect to the crystalline axes. . Author (TAB)

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N68-30077*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
ON THE SOLUBILITIES AND RATES OF SOLUTION OF GASES IN LIQUID METHANE
Robert R. Hibbard and Albert Evans, Jr. Aug. 1968 25 p refs
(NASA-TN-D-4701; E-4324) CFSTI: HC $3.00/MF $0.65 CSCL 21D

Curves are given which permit the easy calculation of the solubilities of oxygen, argon, carbon monoxide, nitrogen, neon, hydrogen, and helium in liquid methane at temperatures between 90 and 112 K. The solubilities of these gases decrease in the order in which they are listed above. It was also found that the rates of solution of gases in liquefied natural gas are very high. It appears that only the least soluble gases, neon, hydrogen and helium can be used as fuel system pressurants if liquefied natural gas is to be used in aircraft. Author

N68-30313*# National Aeronautics and Space Administration, Washington, D. C.
HIGH ENERGY PROPELLANTS: A CONTINUING BIBLIOGRAPHY WITH INDEXES
Jun. 1968 57 p refs
(NASA-SP-7002(04)) CFSTI: HC $3.00/MF $0.65 CSCL 21I

References on high energy propellants announced in the NASA abstract journals during 1967 are presented in this continuing bibliography that contains subjects and author indexes. The 103 references deal with research and development studies on solid, liquid, and hybrid propellants and oxidizers as well as propellant handling and storage, combustion characteristics, toxicity, hazards, and safety measures. M.W.R.

N68-30756# Explosives Research and Development Establishment, Waltham Abbey (England).
THE WETTING OF AMMONIUM PERCHLORATE AND ALUMINUM SURFACES BY THE LIQUID INGREDIENTS OF PLASTIC PROPELLANT
H. Edwards Jan. 1968 26 p refs
(ERDE-24/R/67; AD-670456)

The wetting of the solid constituents of plastic propellant, ammonium perchlorate and aluminum, by the liquid constituents, polyisobutylene and S101 surfactant, has been investigated by contact angle measurements at 25C. With both solids, variable contact angles were obtained with S101 and its individual liquid components. This lack of reproducibility was attributed to the existence of firmly bound layers of moisture on the solid surfaces. The spreading of liquid polyisobutylenes on the solid surfaces was found to be dependent on both surface tension and molecular weight. Author (TAB)

N68-30768# Rocket Propulsion Establishment, Westcott (England).
COMBUSTION OF HETEROGENEOUS CONDENSED SYSTEMS
N. N. Bakhman and A. F. Belyaev Nov. 1967 280 p refs Transl. into ENGLISH of the publ. "Goreniie Geterogennykh Kondensirovannykh Sistem" Moscow, Acad. of Sci. USSR, 1967
(RPE-TRANS-19) CFSTI: HC $3.00/MF $0.65

Basic processes that determine the rate of combustion for various types of flames are considered as is the burning rate

and theory of combustion for condensed mixtures. Details are included for laminar inhomogeneous gas mixtures; combustion of volatile explosions, solid particles, and liquid drops; mixing rate of fuel and oxidizer; and mechanics of transport of particles by a gas stream. Kinetic and diffusion regimes of combustion are treated, some expressions for the burning rate are considered; and the multidimensional character as well as multistage burning of condensed mixtures are noted. Effect of the condensed residue and the dependence of burning rate on pressure are reported. Experimental data are included for the dependence of burning rate on condensed mixtures on particle size and other parameters, mixture ratio, pressure, and initial temperature. The effective of catalytic additives, burning of ammonium perchlorate, burning rate of black powder, and burning in systems consisting of plane or cylindrical layers of fuel and oxidizer are considered. M.W.R.

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N68-29565# Office of Research Analyses, Holloman AFB, N. Mex.

INNOVATION IN LIQUID PROPELLANT ROCKET TECHNOLOGY Final Report

Roderick William Clarke (Ph.D. Thesis—Stanford Univ.) Mar. 1968 348 p refs

(ORA-66-0006; AD-669334)

The investigation identifies patterns of innovation in the technology of liquid propellant rocket engines (LPRE). Quantitative methods are used to gain an understanding of the innovative process based on large-sample statistics. Specifically, it seeks to determine the manner and extent in which LPRE technology innovation has evolved; the degree to which innovations have diffused; and the factors of the environment within which innovation has taken place. The two principal tools used are a modeling of the functional and structural characteristics of LPRE to permit quantitative identification of specific innovations, and a mapping process which traces innovative diffusion through specific communication channels. Author (TAB)

N68-29854*# Pratt and Whitney Aircraft, West Palm Beach, Fla. Florida Research and Development Center.

SINGLE STAGE EXPERIMENTAL EVALUATION OF VARIABLE GEOMETRY GUIDE VANES AND STATORS. PART 1—ANALYSIS AND DESIGN

B. A. Jones and D. L. Wright 2 Aug. 1968 14 p refs

(Contract NAS3-7604)

(NASA-CR-54554; PWA-FR-2112) CFSTI: HC $3.00/MF $0.65 CSCL 21A

An analysis was made to investigate variable geometry concepts for guide vanes and stators that can increase the stable operating range of low hub/tip ratio compressor stages. A variable geometry inlet guide vane, a rotor, and two variable geometry stator configurations were designed for test in a 0.5 hub/tip ratio single stage compressor rig. Vector diagrams and the required blading geometries were defined for design point, axial-inlet operating conditions, and for off-design operation at 70% of design equivalent rotor speed. Compressor inlet screens to provide radial and circumferential distortion were also designed. Author

N68-29953*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

COLD FLOW INVESTIGATION OF A LOW ANGLE TURBOJET PLUG NOZZLE WITH FIXED THROAT AND TRANSLATING SHROUD AT MACH NUMBERS FROM 0 TO 2.0

Donald L. Bresnahan and Albert L. Johns Washington Aug. 1968 39 p refs

(NASA-TM-X-1619) CFSTI: HC $3.00/MF $0.65 CSCL 21E

The performance of a full length plug nozzle can be maintained at a high level by extending the outer shroud with increases in nozzle pressure ratio from 2.5 to the design pressure ratio of 26.3. During acceleration, maximum external flow effects occurred at Mach 1.5 with performance losses of approximately 2.8 percent. At subsonic cruise, this loss was about 4.8 percent. Plug truncations to one-half and one-third of its full length resulted in losses of 1 and 1.7 percent, respectively, at Mach 2.0. Base bleed of about 1.5 percent of the primary flow optimized the performance of the truncated plugs. Author

N68-30040*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

TURBOJET-ENGINE NOISE STUDIES TO EVALUATE EFFECTS OF INLET-GUIDE-VANE-ROTOR SPACING

John L. Crigler, W. Latham Copeland, and Garland J. Morris Washington Aug. 1968 32 p refs

(NASA-TN-D-4690) CFSTI: HC $3.00/MF $0.65 CSCL 21A

Experimental results are presented of a noise study which made use of a turbojet engine having an axial flow multiple stage compressor. The objective of this study was to investigate the effect of increased inlet guide vane–rotor spacing on the compressor interaction noise and engine performance, particularly at partial power conditions. The engine selected for this investigation was in the 2000-pound (8896-newton) thrust category and was readily modified by relocating the inlet guide vane assembly approximately six mean rotor blade chords ahead of the first stage rotor. The data are presented in the form of engine performance curves, noise radiation patterns, and frequency spectra. The data show that there is a substantial noise reduction due to the increased inlet guide vane–first stage rotor axial spacing. The reductions were as much as 14 dB for the condition of 80 percent rated rpm, the highest engine speed at which noise measurements were made. The noise reductions have been accomplished without any measurable loss in engine performance. Stationary components of the compressor which are exposed to pulsating flows are identified as sources of noise and are noted to have characteristic frequencies. Author

N68-30042*# General Dynamics/Convair, San Diego, Calif.

STUDY ON EXHAUST PLUME RADIATION PREDICTIONS Final Report, 1 Jan.–31 Oct. 1967

C. B. Ludwig Jul. 1968 96 p refs

(Contract NAS8-21082)

(NASA-CR-61233) CFSTI: HC $3.00/MF $0.65 CSCL 21B

The object of this program is to measure the absorption coefficients and fine structure parameters of water vapor at wavelengths between 1 and 10 μ and at temperatures between 1200° and 3000°K and to incorporate these into a practical analytic procedure which may be used for the evaluation of the radiative base heating of Saturn 5 and other launch vehicles. A uniform volume of high temperature water vapor was produced above the combustion zone of a long three inch wide flat burner which was constructed for these measurements. Emission and absorption measurements were made with a pathlength of 20 feet. The results obtained have been combined with previous data in order to generate tables of water vapor absorption coefficients covering the spectral region 50 to 9300 cm^{-1} and the temperature interval 300° to 3000°K. The representation of the inverse of the line spacing covers the intervals 1150 to 7500 cm^{-1} in the temperature

range from 600° to 3000°K. A theoretical study of the sensitivity of band models to deviations of the line shape from the assumed Lorentz shape was made and plausible line intensity distribution functions were investigated. Author

N68-30389# Rugby Coll. of Engineering Technology (England).
BREATHING AND SCAVENGING OF FOUR-STROKE DIESEL ENGINES
A. N. Wanchoo Jul. 1967 111 p refs
CFSTI: HC $3.00/MF $0.65

This monograph covers the breathing and scavenging of diesel engines with special reference to four-stroke engines. The subject has been divided into three parts. These are: (a) Theoretical and aerothermodynamic considerations involved in the breathing and scavenging of diesel engines. (b) Experimental investigations into the coefficient of discharge of poppet valves under steady flow conditions and mass flow through a pulse generating machine. (c) Practical considerations in the design of a diesel engine induction and exhaust system with a view to optimize breathing and scavenging. The practical considerations in the design have been linked to the theoretical base on which these are founded. The influences compromising the design have been considered and discussed. Author

N68-30483# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EXPERIMENTAL DETERMINATION OF FUEL-ATOMIZATION QUALITY FROM HIGH-CAPACITY CENTRIFUGAL SPRAY NOZZLES [EKSPERIMENTAL'NOYE OPREDELENIYE KACHESTVA RASPYLIVANIYA TOPLIVA TSENTROBEZHNYMI FORSUN KAMI BOLSHOI PROIZVODITELNOSTI]
Yu. I. Khaukin 1 Sep. 1967 19 p refs Transl. into ENGLISH from Probl. Teploenergetiki i Prikl. Teplofiziki, no. 3, 1966 p 70–79
(FTD-HT-67-235; AD-670102)

An experimental determination was made of the quality of fuel (solar oil) atomization by large capacity (1500 kg/hr) swirl injectors. In the experiments, the pressure before the nozzle was varied from 5 to 60 kg/sq cm, kinematic viscosity of the fuel from 0.04 to 0.4 sq cm/sec, fuel flow rate from 123 to 1322 kg/hr, and Reynolds number from 1640 to 18,280. The quality of atomization was determined by measuring the droplet imprints on a plate coated with solar oil soot 0.5 to 0.7 mm thick. The obtained results are shown. The formula d sub k/d sub e = 18.3/Re to the 0.59 power can be used for calculating the quality of fuel atomization. Author (TAB)

N68-30526# Eidgenossische Technische Hochschule, Zurich (Switzerland).
CONTRIBUTION TO THE INVESTIGATION OF PERFORMANCE BEHAVIOR OF AN ASYNCHRONOUS MOTOR WITH A MASSIVE ROTOR [BEITRAG ZUR UNTERSCHUNG DES BETRIEBSVERHALTENS EINER ASYNCHRONMASCHINE MIT MASSIVEM ROTOR]
Hans Voegele (Ph.D. Thesis) 1967 120 p refs In GERMAN *Its* Dissertation No. 3615
CFSTI: HC $3.00/MF $0.65

Performance analysis on an asynchronous motor with massive rotor showed that its harmonic oscillation moments $n=6a-1$, $a=1,2,3,\ldots$ are running contrary to the direction of the fundamental oscillation moments. The harmonic oscillation moments $n=6a+1$, $a=1,2,3,\ldots$ near $0 \leq W_L < \frac{W_1}{n}$ act in the direction of oscillation moment but have a braking effect on it at $W_1/n < W_L < W_1$. Transl. by G.G.

N68-30599*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PERFORMANCE OF A WIND TUNNEL MODEL OF AN AERODYNAMICALLY POSITIONED VARIABLE FLAP EJECTOR AT MACH NUMBERS FROM 0 TO 2.0
Fred W. Steffen and John R. Jones Aug. 1968 35 p refs
(NASA-TM-X-1639) CFSTI: HC $3.00/MF $0.65 CSCL 21E

A wind tunnel model of a variable flap ejector nozzle with an aerodynamically positioned shroud was evaluated over a range of Mach numbers from 0 to 2.0 at appropriate nozzle pressure ratios and statically at pressure ratios up to 26.0. Various power settings were simulated. Nozzle efficiency, pumping characteristics, boattail floating position, and boattail pressure drag were determined. The nozzle had typically high efficiencies at supersonic cruise and reheat acceleration conditions but rather low efficiency at subsonic cruise and dry acceleration conditions. The aerodynamically positioned shroud was stable at all simulated power settings and free stream Mach numbers. Author

N68-30604*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
M-1 INJECTOR DEVELOPMENT—PHILOSOPHY AND IMPLEMENTATION
Walter F. Dankhoff, Irving A. Johnsen, E. William Conrad, and William A. Tomazic Washington Aug. 1968 68 p refs
(NASA-TN-D-4730) CFSTI: HC $3.00/MF $0.65 CSCL 21H

The M-1 injector design was a cooperative effort to achieve high performance with completely stable operation. The approach was based on the technology already established in the RL-10 and J-2 engine development programs, supplemented with the latest data obtained at NASA–Lewis. Small scale tests were conducted to verify design concepts prior to incorporation into the full scale hardware. Full scale injector testing demonstrated that the design goals were achieved. Author

N68-30683# National Research Council of Canada, Ottawa (Ontario). Mechanical Engineering Div.
DATA REDUCTION PROGRAM FOR FREE PISTON ENGINE TESTS
F. Reuter Dec. 1967 38 p refs
(DME-ME-224; NRC-9971; AD-670236)

A program, written in FORTRAN IV for the IBM 360 computer, for the reduction of data from free piston engine tests is described, along with a brief description of the engine and its instrumentation, and the derivation of the various equations used. Input data are in the form of punched cards, and output, in tabulated form, is on the standard line printer. At the option of the user, some of the more important output data may, in addition, be plotted on the EAI dataplotter. Author (TAB)

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N68-29585
ABSORPTION OF SOFT X-RADIATION IN THE INTERSTELLAR MEDIUM AND SPECTRUM OF THE SOURCE SCOXR-1
L. A. Vainshtein, V. G. Kurt, and E. K. Sheffer [1968] 4 p refs Transl. into ENGLISH from Astron. Zh. (Moscow), v. 45, no. 2, 1968 p 237–240
CFSTI: HC $3.00/MF $0.65

An attempt is made to explain the visibility of flares with a slightly different temperature (200°) from that of the photosphere. Formulas are presented for obtaining the temperature distribution over the solar disk from the spectrophotometric gradient, for calculating the contrast between flare and photosphere, and for

correcting the calculated values for atmospheric light scattering. An explanation is also given for the gradual disappearance of flares as they move toward the center of the solar disk. K.W.

N68-29606
ON THE VISIBILITY OF PHOTOSPHERE FLARES ON THE SOLAR DISC
N. F. Voikhanskaia [1968] 5 p refs Transl. into ENGLISH from Tr. Astron. Observ. (Leningrad), v. 22, 1968 p 120–124
CFSTI: HC $3.00/MF $0.65

An attempt is made to explain the visibility of flares with a slightly different temperature (200°) from that of the photosphere. Formulas are presented for obtaining the temperature distribution over the solar disk from the spectrophotometric gradient, for calculating the contrast between flare and photosphere, and for correcting the calculated values for atmospheric light scattering. An explanation is also given for the gradual disappearance of flares as they move toward the center of the solar disk. K.W.

N68-29700#
COMPARATIVE STUDY OF THE HYDROGEN LINES IN THE SPECTRA OF FLARES AND THE UNPERTURBED PHOTOSPHERE
N. F. Voikhanskaia [1967] 9 p Transl. into ENGLISH from Tr. Astron. Observ. (Leningrad), v. 24, 1967 p 73–82

Hydrogen lines are studied in order to gain information on the electron concentration and effective temperature of flare regions. Spectrograms are analyzed which were taken with a solar telescope with an image diameter of 203 mm and inverse second order dispersion in the domain of the D line 0.98 Å/mm. The unperturbed photosphere was taken immediately adjoining to the flare but receding from the spectrum band of the flares so as to emerge distinctly out of the flare domain. Also attempted was an estimate of the effective temperature of the flare domains, for the purpose of which the dependences of the equivalent width versus spectrum class were constructed for each line by means of data for stars of the V class of radiance. K.W.

N68-29739# Centre d'Etudes et de Recherches en Technologie Spatiale, Toulouse, France.
COMPUTATION OF MAGNETIC COORDINATES B,L BY THE PERTURBATION METHOD. COMPUTER PROGRAM FOR RADIATION DOSAGE [CALCUL DES COORDONNEES B,L PAR PERTURBATIONS. PROGRAMME DE CALCUL DES DOSES]
J. Brettes, G. Lavel, R. Peliat, and J. P. Philippon Feb. 1968 30 p refs In FRENCH
(CERTS-NT-01-8) CFSTI: HC $3.00/MF $0.65

Satellite lifetime and satellite equipment lifetime depend on the amount of radiation they are encountering during one revolution. Geographical coordinates can be deduced from orbit elements. These coordinates are transformed into Mac Ilwain magnetic coordinates B,L using the perturbation theory. This transformation is explained and discussed. It is shown that the accuracy of the method is of the same order as the transformation performed by the Vette method but the computation involves only 1/5 of the machine time. Radiation doses received can then be deduced from electron and proton files. Author

N68-29776# American Meteorological Society, Boston, Mass.
COHERENT AMPLIFICATION OF RADIO EMISSION IN THE COSMIC MEDIUM [KOGERENTNOE USILENIE RADIOIZLUCHENIYA V KOSMICHESKOI SREDE]
D. A. Varshalovich Nov. 1966 9 p ref Transl. into ENGLISH from Zh. Eksperim. Teor. Fiz. (Moscow), v. 4, no. 5, 1966 p 180–182 In ENGLISH and RUSSIAN
(Contract AF 19(628)-3880)
(T-R-635; AD-669164)

In hydrogen atoms located in an oriented flux of nonpolarized ultraviolet radiation with a continuous spectrum in the 1216-912A region, an inversion occurs in the population of the hyperfine structure levels of the ground state 1 sub S 1/2. The foregoing provides grounds for believing that coherent amplification of radiation is a widespread phenomenon in the universe. Author (TAB)

N68-29915*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
LARGE VELOCITY DISCONTINUITIES IN THE SOLAR WIND
L. F. Burlaga Jun. 1968 36 p refs
(NASA-TM-X-63287; X-616-68-293) CFSTI: HC $3.00/MF $0.65 CSCL 20H

In the course of 3000 hours observation of the interplanetary plasma, the plasma and magnetic field experiments on Explorer 34 have detected eleven discontinuous solar wind speed changes, not associated with shocks, of more than 60 km/sec in less than three minutes. These events, called uD's, may show a velocity change of either sign, but the plasma density and temperature are not found to change appreciably across them. Each speed discontinuity occurs simultaneously with a directional discontinuity in the magnetic field. High resolution magnetic field data show that sometimes the directional changes occur as rotational fans, and at other times they are erratic or occur within the time resolution of the magnetic field experiment, 2.6 sec. The flow direction of the solar wind changed at two of eleven uD's. The quiet nature of the field and plasma on each side of these events gives the impression that they are stable. The existence of these uD's is shown to be consistent with the theory of the Helmholtz instability. In particular, the additional observation that the magnetic field direction change, ω, at a uD tends to be near 90° is consistent with the theory, for uD's with small ω may become unstable as they move from the sun. Author

N68-29926*# Volt Technical Corp., Washington, D. C.
PLASMA MEASUREMENTS CONDUCTED IN THE VICINITY OF VENUS ON THE SPACECRAFT VENERA-4
K. I. Gringauz, V. V. Bezrukikh, L. S. Musatov, and T. K. Breus 30 Jul. 1968 11 p ref Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 6, no. 3, May–Jun. 1968 p 411–419
(Contract NAS5-12487)
(NASA-CR-95835; ST-LPS-PA-10734) CFSTI: HC $3.00/MF $0.65 CSCL 03B

Preliminary results are presented of plasma flux measurements by charged particle traps carried out in the near-planetary flight sector of spacecraft "VENERA-4". The increase in plasma fluxes detected at distance ≈19,000 km, is explained by VENERA-4 crossing the shock wave front formed in the vicinity of the planet. Considerations are brought out on the low charged particle concentrations measured in the night ionosphere of Venus. Author

N68-30148# Centre National d'Etudes Spatiales, Bretigny-sur-Orge (France). Satellite Div.
CALCULATION OF RADIANT POWER INCIDENT UPON AN EARTH ORBITING SATELLITE [CALCUL DES PUISSANCES RADIANTES RECUES PAR UN SATELLITE SUR ORBITE TERRESTRE]
J. P. Delpont, J. F. Faugere, and J. P. Philippon Jan. 1967 30 p refs In French
(CNES-NT-6) CFSTI: HC $3.00/MF $0.65

A method is presented for calculating the solar flux, albedo, and terrestrial thermal flux received by a satellite in earth orbit. The use of a Fortran program for making these calculations is discussed. Transl. by M.G.J.

N68-30231# Air Force Cambridge Research Labs., Bedford, Mass. Space Physics Lab.

OBSERVATION AND FORECASTING OF SOLAR PROTON EVENTS

John P. Castelli Mar. 1968 28 p refs *Its* AF Surveys in Geophys., No. 203

(AFCRL-68-0104; AD-669347)

Solar burst characteristics in the radio microwave region are used to differentiate between large flares that might produce proton events and those that might not. Proton events produce high-level absorption, disrupt polar communications, and can be dangerous to man and equipment in space. They may precede the auroral and magnetic storms that disturb many radiowave propagation systems. The probability of a proton event can now be predicted, an AFCRL study of the characteristics of flare-associated centimeter radar bursts having established that a signature of proton events is a high flux density in the 3-cm region and a particular burst peak flux spectral configuration. Author (TAB)

N68-30247

ON THE DIFFUSE X-RAY BACKGROUND OF COSMIC SPACE

L. A. Vainshtein, V. G. Kurt, S. L. Mandel'shtam, L. P. Presniakov, S. I. Syrovatskii, et al 1968 6 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 6, no. 2, 1968 p 242–246

CFSTI: HC$3.00/MF$0.65

Experimental results of measuring the x ray isotropic background in the E > 1 kev range, including new measurements in the range around 1.25 kev, are considered. Two brehmsstrahlung are analyzed to explain the x ray background: (1) Compton radiation of metagalactic relativistic electrons, and (2) brehmsstrahlung of the heated metagalactic gas. In the latter case, an intergalactic medium density of ≈ 0.2 from the critical, and an intergalactic gas temperature of 3 to 10 × 10^7°K were most probable. S.C.W.

N68-30430# Utrecht Observatory (Netherlands).

OBSERVATION OF SOLAR LINE PROFILES. 1: THE CENTRE-TO-LIMB VARIATION OF PROFILES OF FIFTY LINES IN THE NEAR INFRARED SOLAR SPECTRUM

C. De Jager and L. Neven (Roy. Obs., UCCLE) 1967 72 p refs Repr. from Bull. Astr. Inst. (Netherlands), sup. 1, 1967 p 325–396

The profiles of fifty fraunhofer lines between λλ6561 and 10965Å were observed with high-dispersion solar spectrograph. The observations were made for six values of cos θ between 0.3 and 1.0 along a radius making an angle of about 30° with the meridian through the disk centre. The lines belong to ten different elements and are for the greater part of fairly high excitation potential. The observations were made photo-electrically; on the average each line, at each cos θ-value, has been observed 4 or 5 times so that the resulting mean profiles have a great accuracy. The investigation involved also the determination of the photometric properties of the instrument, such as the linearity, the blaze properties of the grating, the apparatus profile, and the intensities of stray light and Rowland ghosts. Author

N68-30462# Sterrewacht Sonnenborgh, Utrecht (Netherlands).

COLLISIONAL DAMPING IN THE WINGS OF THE NA-D AND MG-B LINES IN THE SOLAR PHOTOSPHERE

Roland Hendrickx 1966 15 p refs

(REPT.-25) CFSTI: HC$3.00/MF$0.65

An empirical method is applied for computing the depth-dependence of the damping constant of a Fraunhofer line (or multiplet), based on a solar model and the assumption of local thermal equilibrium. By comparing the empirical damping constant with the theoretical value, it is possible to determine the abundance of the element considered and the value of the interaction constant for collisions with electrons provided that the interaction constant for collisions with neutral H-atoms is known. Author

N68-30463# Utrecht Observatory (Netherlands).

SPECTROSCOPIC DATA FOR SIXTY NEW MODEL PHOTOSPHERES

C. De Jager and L. Neven (Roy. Obs., UCCLE) 1967 236 p refs Repr. from Bull. Astr. Inst. (Netherlands), sup. 2, 1967 p 125–236

CFSTI: HC$3.00/MF$0.65

Physical parameters and weighting functions are given for sixty model photospheres. The model photospheres cover approximately the range of spectral types between O and late G stars. For these photospheres the following properties were computed: fluxes between 911 and 5698Å; U, B and V values; the Balmer discontinuity; profiles of Hγ and Hδ; profiles of the He 2 lines at 4542Å and 4686 Å, and the equivalent widths of 78 lines of helium, carbon, nitrogen, oxygen, magnesium, silicon, calcium and strontium. Author

N68-30710# Sandia Corp., Albuquerque, N. Mex. Scientific Translation Service.

SOLAR NEUTRONS: EXPERIMENT ORGANIZED BY THE ARGENTINE NATIONAL CENTER OF COSMIC RADIATION (CNRC) [NEUTRONES SOLARES: EXPERIMENTO PROYECTADO POR EL CNRC]

H. S. Ghielmetti 8 Apr. 1968 9 p refs Transl. into ENGLISH from Spanish Presented at the Intern. Solar Eclipse Symp., Brazil, 5–9 Feb. 1968

(SC-T-68-1518; CONF-680208-2) CFSTI: HC$3.00/MF$0.65

An experiment planned by the CNRC for the total solar eclipse of November 12, 1966 is briefly described. Its main purpose was to determine the presence, near the top of the atmosphere, of a flux of fast neutrons of solar origin. The high geomagnetic cutoff of the region covered by the total eclipse, and, as a consequence, the low background of albedo and secondary neutrons; and, on the other hand, the relatively large dimensions of the detector to be used, should permit an establishment of upper limits for the solar fast neutron flux, by observing its variations during the partial and total coverage of the Sun by the Moon. Strong winds blowing at the time of launching destroyed the 15,000-m^3 plastic balloon, thus aborting the project. Author (NSA)

N68-30733# Utrecht Observatory (Netherlands).

CHROMOSPHERIC PROBLEMS AND THEIR INVESTIGATION WITH A LARGE ASTRONOMICAL SATELLITE

M. Minnaert Utrecht, Netherlands Sterrewacht Sonnenborgh [1968] 9 p

(REPT.-50) CFSTI: HC$3.00/MF$0.65

Problems relating to the spicular structure of the chromosphere in the deeper layers between 1500 and 10,000 km are investigated. Essential problems focused on were: (1) Do spicules also occur at lower levels and what fraction of the total area do they occupy at each height? (2) How do temperature and electron density vary with height, both in the spicules and in the interspicular region? (3) Are the abundances the same in the chromosphere and lower corona as in the photosphere? (4) What is the difference between the chromospheric structure above normal regions and above plages? Answers to these questions have been derived from the following observational data obtained from the earth: (1) the spectrum on the disc (central intensities of Fraunhofer lines); (2) the spectrum just outside the limb (flash spectrum); (3) the photometry of the continuum outside the limb giving the total number of electrons in the line of sight as a function of height; (4) filtergrams and spectroheliograms; and (5) the radioflux between wavelengths of 1 mm and 30 cm. Considered is how these methods of observation may be applied and extended by making use of the possibilities of a satellite. S.C.W.

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N68-29633# Royal Aircraft Establishement, Farnborough (England).
THE ORBIT OF SECOR 6 (1966-61 B)
R. H. Gooding and Rosemary Milner Nov. 1967 17 p refs
(RAE-TR-67283) CFSTI: HC $3.00/MF $0.65

The orbit-determination program PROP was used to determine the orbit of Secor 6 from Minitrack observations at 22 epochs during the periods of September to November 1966 and January to February 1967. Author (ESRO)

N68-29672*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SPECTROPHOTOMETRY OF LUNAR FORMATIONS
A. N. Sergeyeva Redstone Arsenal, Ala. Redstone Sci. Inform. Center 26 apr. 1968 19 p refs Transl. into ENGLISH from Akad. Nauk SSSR Komis. Po Fiz. Planet Izv. (USSR), 1959 p 59-66 Prepared jointly with Army Missile Command
(NASA-TM-X-61023; RSIC-797) CFSTI: HC $3.00/MF $0.65 CSCL 03B

Preliminary results of the spectrophotometry of lunar details are given. The observations were carried out with the help of a quartz spectrograph and a horizontal telescope having a spherical mirror (f = 8 meters). It was found that the color contrasts are absent in most cases. Sometimes they amount to 10 to 15 percent and in rare cases reach 20 percent. The lunar cirques and mountain formations have reddish hues in comparison with the seas The last are bluish-greenish but the Sea of Serenity and the Sea of Rains proved to be reddish. Author

N68-29674
OPTIMUM RENDEZVOUS IN ORBIT
Iu. G. Sikharulidze [1968] 7 p refs Transl. into ENGLISH from Izv. Vyssch. Ucheb. Zaved., Aviats. Tekh. (Kazan), no. 1, 1968 p 28-34
CFSTI: HC $3.00/MF $0.65

The coplanar rendezvous of a maneuvering spacecraft with a target in the form of a satellite in a circular orbit is considered. The vehicle is assumed to have been injected into the neighborhood of the satellite at a range ρ_0 and a relative velocity V_0. It is further assumed that the vehicle has one engine with a constant exhaust velocity and a thrust regulated within assigned limits because of the change in the fuel consumption per second. A thrust vector program which is optimum for fuel consumption and which assures transition of the vehicle from the initial to the final state is determined. K.W.

N68-29693 Utah Univ., Salt Lake City.
A FUNDAMENTAL STUDY OF CRATERING IN GRANULAR MATERIALS WITH AN APPLICATION TO LUNAR CRATERS
Kay Sherman Mortensen (Ph.D. Thesis) 1967 158 p
Available from Univ. Microfilms: HC $7.40/MF $3.00 Order No. 67-10723

Relevant results from the theory of shaped charge penetration were reviewed the results were then extended to the case of a non-deforming projectile and a material with a constant flow stress. The results were further extended to a material with a flow stress that depends on pressure or alternately on depth of penetration. Experimental studies using sand of various particle sizes and various projectiles, were performed in the velocity range from about 10 meters/second to 1000 meters/second. A particle size effect for the target material and a correlation factor for different projectile shapes were discovered. Photographic studies of the cratering process were also performed. These studies lend further support to the approach used in this study. Application of cratering results to cratering in a postulated two-layered moon model permits a ready explanation of the large size lunar craters without the necessity of assuming extraordinarily large planetoids or other large celestial impacting bodies. The diameter ratio for a crater in sand to that in rock for the same impacing energy is about 40, thus the meteorite that caused the one mile diameter crater in Arizona could cause a crater of the order of 40 miles in diameter on the moon. Dissert. Abstr.

N68-29696 Colorado Univ., Boulder.
A NECESSARY CONDITION AND A CORNER CONDITION FOR OPTIMAL COPLANAR ORBIT TRANSFER
Robert Dudley Culp (Ph.D. Thesis) 1966 108 p
Available from Univ. Microfilms: HC $5.40/MF $3.00 Order No. 67-10034

The problem considered is that of determining the means of orbit transfer in a Newtonian gravitational field which minimizes the characteristic velocity of the maneuver. The available thrust magnitude is assumed to be unlimited. The time duration of the maneuver is not considered. This restricts the analysis to the so-called time open problem, in which case only elliptical transfers between elliptical orbits need be considered. All motion is restricted to a plane. The sense of circulation in the orbit is not restricted. This analysis yields a necessary condition which must be satisfied in order that a maneuver be optimal. In addition, this study produces a corner condition which must be satisfied at the junction of two maneuvers in order that the entire maneuver be optimal. It is shown that optimal manauvers are nearly always composed of finite impulses. Continuous thrust optimals are very rare special cases and are treated only briefly. Dissert. Abstr.

N68-29698 Case Inst. of Tech., Cleveland, Ohio.
A STUDY OF THE CEPHEUS 4 ASSOCIATION
Darrell Jack Mac Connell (Ph.D. Thesis) 1966 164 p
Available from Univ. Microfilms: HC $7.60/MF $3.00 Order No. 67-11558

Spectral classification, photometry, and surface distribution of 113 O and B stars, stars near the central cluster, Hα-emission stars, variable stars, central stars in reflection neubise, and a flare star in the region of the Cepheus IV association have been obtained and studied to provide knowledge of the membership, distance, reddening, and age of the association. The presence and outline of a large, dark cloud is confirmed by the color excesses of the luminous member-stars. A rough, star-count analysis independently shows that the obscuring cloud has the approximate distance and absorbing power as found from the bright member-stars. Most of the O and B stars observed in the region appear to be members of the association, as are the known Be stars and an eclipsing binary. Several of the Hα-emission stars are expected to be members of the T Tauri-class, and these are also probably members of the association. The surface distribution of the stars in reflection nebulae relative to the dark cloud indicates that they are probably members. Dissert. Abstr.

N68-29702 Yale Univ., New Haven, Conn.
PHOTOELECTRIC PHOTOMETRY OF SOME SELECTED VARIABLES
Eugene Frank Milone (Ph.D. Thesis) 1967 219 p
Available from Univ. Microfilms: HC $9.90/MF $3.00 Order No. 67-10712

Five variable stars were studied by photoelectric photometry. Two of these (CG Cygni and RT Lacertae) are eclipsing binaries with

unequal maxima in their light curves, and three (SU Cassiopeiae, SZ Tauri and SW Tauri) are Cepheid variables suspected of anomalies in their light curves. The cause of none of these phenomena is understood. The finest UBV light curves on these stars to date were obtained. None of the Cepheids exhibit significant anomalies in their light curves during the period of observations, although one of them (SZ Tau) has a three day period--a) SZ Tauri is revealed to have almost perfect sinusoidal light curves, contradicting earlier data. b) SW Tauri has a double-peaked rather than a flat maximum, as had previously been reported. Both binaries are brighter at the secondary maximum in all colors and their light curves appear to be variable with both a long and a short term change. Author

N68-29718# Geophysics Corp. of America, Bedford, Mass.
ATMOSPHERIC INFERENCES FROM PLANETARY LIMB DARKENING Final Report, 17 Dec. 1965–30 Apr. 1967
Jean I. F. King Apr. 1968 38 p refs
(Contract AF 19(628)-5738)
(GCA-TR-68-1-A; AFCRL-68-0188; AD-669377)

The theory of planetary limb darkening is developed using a parabolic limb approximation to account for the curvature of the atmosphere. The inapplicability of the plane parallel model for structural inferences from planetary limb observations is demonstrated. Closed form expressions are obtained for the optical depth, weighting function, and other radiance parameters appropriate to the problem. The peaked character of the weighting function resulting from the curved geometry makes possible, as a first approximation, a direct point-to-point inversion of the radiance profile to obtain the temperature structure. The theory is applied to the Venus limb observations of Westphal (1966) and the inferences and limitations of the data are discussed. Finally, the similarity of the radiance equation to Abels integral leads to the expectation that the full-blown inversion problem is amenable to solution. Author (TAB)

N68-29743# Royal Aircraft Establishment, Farnborough (England).
ORBIT EXPANSION BY MICROTHRUST. PART 1: DESCRIPTION OF RESULTS
G. J. Davidson Sep. 1967 21 p refs Prepared for ELDO
(RAE-TR-67243) CFSTI: HC $3.00/MF $0.65

This report describes the results of a study carried out for ELDO on the subject of orbit expansion from low to geostationary altitude by means of microthrust provided by an electric propulsion unit. The mathematical analysis of the problem and the computer program used to obtain the results presented herein are each published under a separate cover. ESRO

N68-29754# Centre d'Etudes et de Recherches en Technologie Spatiale, Toulouse (France).
INTRODUCTION TO THE PHYSICS OF THE SPACE ENVIRONMENT [INTRODUCTION A LA PHYSIQUE DU MILIEU SPATIAL]
C. Elbaz Feb. 1968 63 p refs In FRENCH
(CERTS-NT-05-4) CFSTI: HC $3.00/MF $0.65

Data on earth atmosphere and its subdivisions as function of altitude and temperature, density, chemical composition, ionization are recalled.Measuring methods to collect these data are indicated. Geomagnetism is explained as well as the mathematical model representing the magnetosphere. Extraterrestrial radiation is analyzed. Solar wind and artificial radiation belts are explained. Author (ESRO)

N68-29767 California Univ., Berkeley.
RADIATION ANOMALIES ON THE LUNAR SURFACE
David Buhl (Ph.D. Thesis) 1967 174 p
Available from Univ. Microfilms: HC $8.00/MF $3.00 Order No. 67-11602

A model of the Moon, which consists of a large number of centimeter and millimeter size craters distributed over the surface, is proposed to account for several of the anomalous results of infrared observations. These observations have shown that the temperature of the subsolar point depends on the angle of observation. In addition, thermal hot spots appear during a lunar eclipse. Such anomalous observations are interpreted as indicating the presence of small craters. In calculating the effect of small scale cratering on observations of the illuminated and eclipsed Moon, a number of physical processes are considered. A detailed calculation of the effect of radiation interchange within the crater is made. Curves are plotted to the infrared brightness of the illuminated crater as a function of the angle of the observer, taking into account the effects of reradiation, local incidence and emission angles, and shadowing. Dissert. Abstr.

N68-29810# Air Force Cambridge Research Labs., Bedford, Mass. Optical Physics Lab.
NEAR INFRARED PHOTOMETRY OF LATE TYPE STARS
Russell G. Walker Feb. 1968 33 p refs Presented at the Discussion Meeting on Infrared Astronomy, Royal Society, London, 1 May 1967 *Its* Environ. Res. Papers No. 281
(AFCRL-68-0042; AD-669566)

A multi-band photoelectric photometer for making observations in the U, B, V, and infrared bands W(1.06 microns) X(1.13 microns), Y(1.63 microns) and Z(2.21 microns) was constructed and applied to both stellar and planetary observations. The results of photometry obtained for 61 stars are presented. The observations at lambda = 1.63 microns are shown to exhibit an excess flux due to a minimum in the H opacity in accordance with the predictions of model atmosphere studies. Bolometric corrections are derived for stars of late spectral type from integration of the observed absolute spectral irradiance curve. A simple photometric method for measuring stellar diameters is proposed based upon the absolute irradiance observed at 2.21 microns and the 2.21 microns flux at the surface of the star calculated from model atmospheres. Angular diameters derived by this technique are consistent with interferometric results and, when combined with the bolometric corrections, effective temperatures are found. Author (TAB)

N68-29844#
SOME GENERAL QUESTIONS OF THE THEORY OF ASTROPHYSICAL RECOMBINATION SPECTRA OF COMPLEX ATOMS, 1
A. A. Nikitin 1968 10 p refs Transl. into ENGLISH from Tr. Leningrad Univ. Astron. Observ., v. 24, 1967 p 3–13
CFSTI: HC $3.00/MF $0.65

Structure of trapping ions and their influence on the recombination spectra of complex atoms were studied, and an analysis was made of the kinds of vector couplings and their method of selection for use in a stellar recombination spectrum. The case is considered when the spin-orbital interaction is sufficiently great as is usual in multply ionized or very heavy elements; and the writing of the "stationary" equations for the different excitation levels is discussed. It is noted that in a multiconfiguration approximation, the true wave function of any state is expressed by a linear combination of two or more functions and appropriate weight factors. Some examples are included for transitions related to astrophysical recombination spectra, and the necessary mathematical models are detailed. M.W.R.

N68-29848 Pennsylvania State Univ., University Park.
PLANETARY APPROACH AND ENTRY DYNAMICS FOR MANNED FLIGHT
James David Porter (Ph.D. Thesis) 1968 161 p
Available from Univ. Microfilms: HC $7.60/MF $3.00 Order No. 67-11222

The equations of motion for flight in the atmosphere were combined into a second order non-linear, ordinary differential equation by the introduction of the energy parameter as the independent variable. Using perturbation techniques, a first order analytic solution to the entry equation was obtained and was found to be comparable to previous second order solutions to entry equations derived by using velocity parameters as the independent variables. A second order solution to the new entry equation was obtained numerically and yielded entry profiles which were in good agreement with the results obtained by direct integration of the equations of motion. Since only two equations must be integrated by the new method it is faster than direct integration of the equations of motion. With the use of the above solution and appropriate definition of corridor limits, safe entry corridors for manned flight into the Venusian atmosphere were obtained for a variety of vehicle and atmospheric characteristics. An analysis of the trajectories showing the effects of changing vehicle and atmospheric characteristics revealed the possibility of dynamically simulating entries of vehicles into the Venusian atmosphere by vehicles of different characteristics into the earth's atmosphere.
Dissert. Abstr.

N68-29867# Royal Aircraft Establishment, Farnborough (England).
ORBIT EXPANSION BY MICROTHRUST. PART 3. FORTRAN COMPUTER PROGRAMME
G. J. Davison Feb. 1968 28 p refs
(RAE-TR-68029, Pt. 3; AD-833409)

This report gives a detailed description of the computer programme which has been written to calculate the transfer time and mass of fuel required in transferring from a low equatorial parking orbit to a geostationary orbit, using a variety of low thrust electric propulsion systems. The equations of motion are summarized and the air drag and earth shadowing equations derived.
Author (TAB)

N68-29869*# National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York.
PULSAR MODELS
W. J. Cocke and Jeffrey M. Cohen 1968 17 p refs
(NASA-TM-X-61028) CFSTI: HC $3.00 CSCL 03B

The possibility was considered that the recently observed pulsed radio sources are pulsating white dwarfs. The results of radial mode eigenvalue calculations (for various central densities and compositions) which were obtained by integrating the eigenvalue equations themselves rather than by using variational techniques are presented. Computation of non-linear white dwarf pulsations are then presented, in which a hydrodynamic code was used to follow finite amplitude pulsations driven by pycnonuclear reactions. Very large amplitude pulsation of neutron stars are also considered. The possibility that the optical pulsation periods are twice as long as the radio periods has arisen from observations. We discuss a method for such a "frequency doubling" based partly on magnetohydrodynamics.
Author

N68-29877*# Volt Technical Corp., Washington, D. C.
MAGNETIC FIELD INVESTIGATIONS WITH AIS "VENERA-4"
Sh. Sh. Dolginov, E. G. Yeroshenko, and L. N. Zhuzgov Greenbelt, Md. NASA Goddard Space Flight Center 30 Jul. 1968 24 p refs Transl. into ENGLISH from the Russian preprint (Moscow), 1968 Submitted for publication
(Contract NAS5-12487)
(NASA-CR-95834; ST-LPS-PMF-10730) CFSTI: $3.00 CSCL 03B

This paper gives a detailed description of magnetic field observations in the interplanetary sector of VENERA-4's trajectory, between 23000 and 200 kilometers from the center of planet VENUS. Description is given of the instrumentation consisting of a three-electrode ferrosonde magnetometer. The conclusions derived from this experiment rule out the existence of any substantial proper dipole magnetic field of Venus. The pattern of field and plasma distribution in the near-planetary sector is, however far from trivial and calls for further studies. At this time this pattern is in no way inconsistent with the concept that VENERA-4 crossed the shock front near ~23000 km. More prolonged observations are required and emphasis should be given to the diurnal side. These data may eventually throw light on the internal structure of Venus and on the interaction mechanisms between the magnetized solar wind plasma and the heavenly bodies.
Author

N68-29883# Royal Aircraft Establishment, Farnborough (England).
ORBIT EXPANSION BY MICROTHRUST. PART 2: ANALYSIS
A. J. Sarnecki Jan. 1968 41 p refs Prepared for ELDO
(RAE-TR-68008) CFSTI: HC $3.00/MF $0.65

By consideration of the vector equations of motion, formulas are derived suitable for use in a computer program to determine the orbital development of a satellite driven by microthrust from a low parking orbit to a high (e.g. geostationary) orbit. Differences between the effects of continuous and interrupted thrust are highlighted and the procedure for the complete removal of eccentricity described.
Author (ESRO)

N68-29932 California Univ., Berkeley.
TRANSPORT COEFFICIENTS OF DEGENERATE STELLAR MATTER
William Bogel Hubbard, Jr. (Ph.D. Thesis) 1967 86 p
Available from Univ. Microfilms: HC $4.60/MF $3.00 Order No. 67-11633

Quantum mechanical Kubo expressions are employed to evaluate the electrical conductivity, thermal conductivity, and shear viscosity for a degenerate electron gas in the Lorentz gas approximation. The validity of the Lorentz gas approximation is discussed. The mean free path of the electrons is shown to depend on the pair distribution function of the ions, and is evaluated analytically in the limit of ion weak coupling, and numerically for ion strong coupling. Previous theories of thermal conduction in degenerate stellar matter are shown to be accurate to within about an order of magnitude. Possible observable consequences of ionic interactions on white dwarf structure and evolution are discussed.
Dissert. Abstr.

N68-29949*# Princeton Univ., N. J. Dept. of Aerospace and Mechanical Sciences.
AEROSPACE SYSTEMS AND MISSION ANALYSIS RESEARCH Status Report, 1 Jan.–30 Jun. 1968
P. M. Lion and M. Handelsman 23 Jul. 1968 18 p refs
(Contract NASr-231)
(NASA-CR-95806) CFSTI: $3.00 CSCL 22C

An overview is presented on research pertaining to space flight trajectory and aerospace systems analysis. It is reported: (1) Basic modules for the trajectory compiler were written in machine language for the IBM 360 computer. The compiler was linked with the TOMCAT n-body and patched conic routines and the general purpose iterator for executing such trajectory segments as launch, state, impulse, integrate, two body, drop mass, and reference change. (2) Analytical work continued on the two-variable expansion technique with a nonlinear time scale for obtaining approximate solutions for low thrust trajectories, and on the problem of approximate solutions for finite thrust trajectories. (3) Research also continued on optimal, fixed thrust, elliptic spiral trajectories in planetocentric fields; and on the application of variable thrust solutions to solar-electric missions for Mars orbiters in order to establish an upper bound on mass performance for comparison with all chemical propulsion planetary maneuvers. (4) A mathematical model for nuclear rocket engines was completed and implemented on the 7094 digital computer as a computer code.
M.G.J.

N68-29988*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
MARS LANDING MISSION MODE COMPARISON
James J. Taylor and John T. McNeely Washington Aug. 1968 49 p refs
(NASA-TM-X-1629) CFSTI: HC $3.00/MF $0.65 CSCL 22A

Four modes of landing a vehicle on Mars are compared in this document. In addition, several variations to these four basic mission modes are suggested. The most efficient mission mode for a Mars landing depends on the type of trajectories used. Author

N68-30060 New York Univ., N. Y.
EXISTENCE OF QUASI-PERIODIC SOLUTIONS TO THE THREE-BODY PROBLEM
Burton Barnet Lieberman (Ph.D. Thesis) 1967 111 p
Available from Univ. Microfilms: HC $5.60/MF $3.00 Order No. 67-10982

The subject of this dissertation is a proof of the existence of quasi-periodic solutions with two rationally independent frequencies to the planar three-body problem. The physical interpretation of the solution is the following: two planets of sufficiently small mass when compared with the third mass move with rationally independent frequencies on essentially elliptical orbits about the third body. The ratio of the distance between the first and third body and the second and third body is also sufficiently small. A unique feature of the solution is that the mean value of the difference of the perihelion motion is zero; i.e., the third possible degree of freedom in the planar problem, the difference of the perihelia, has zero frequency of rotation. In addition, another new feature is that the eccentricity of one of the elliptical orbits may be finite, while the other eccentricity is required to be small. Dissert. Abstr.

N68-30080# Lincoln Lab., Mass. Inst. of Tech., Lexington.
A RADAR INTERFEROMETER STUDY OF VENUS AT 3.8 CM
Alan E. E. Rogers, Tor Hagfors, Richard A. Brockelman, Richard P. Ingalls, James I. Levine et al 14 Feb. 1968 111 p refs
(Contract AF 19(628)-5167)
(ESD-TR-68-18; TR-444; AD-670167)

The 120-foot antenna of the Haystack Microwave Facility and the 60-foot antenna of the Westford Communications Terminal, both operated by M.I.T. Lincoln Laboratory, were coupled to form a planetary radar interferometer operating at X-band and were used to observe Venus at a wavelength of 3.8 cm during the 1967 inferior conjunction. The antennas are separated by approximately 4000 feet along a line 22 degrees east of north. At maximum projection in the direction of the planet, this baseline gives a fringe spacing of 5 seconds of arc, or a maximum of about 10 fringes across the planetary disk at inferior conjunction. By transmitting a CW signal from the 120-foot antenna and frequency analyzing the received echo, it was possible to resolve the planetary surface scattering into strips parallel to the apparent axis of rotation. Crosscorrelation of the complex frequency components obtained at the two sites yielded corresponding spatial Fourier components which resolved the scattering along the strips. With 1-Hz frequency resolution and a maximum of 10 fringes along the rotation axis, the planetary hemisphere visible to the radar during inferior conjunction was mapped with approximately 100 resolution intervals along a direction perpendicular to the apparent rotation axis, with 10 resolution intervals in the orthogonal direction. For a limited region on the planet, surrounding the center of the visible disk, higher resolution was obtained by transmitting pulses of 500-microsec effective length. Maps obtained from the observations show Venus to be smoother on the average than the moon at 3.8 cm, although some regions of the planet exhibit strong local radar-scattering enhancement. Author (TAB)

N68-30098*# Douglas Aircraft Co., Inc., Santa Monica, Calif.
PLANETARY FLIGHT HANDBOOK. PART 6: MARS STOPOVER MISSION USING VENUS SWINGBYS
Washington NASA 1968 98 p refs
(Contract NAS2-4175)
(NASA-SP-35, Pt. 6) GPO: HC $0.75; CFSTI: MF $0.65 CSCL 22C

Trajectory data are presented to aid in planning stopover missions to Mars that employ the Venus swingby mode, which yield substantial reductions in propulsive velocity and Earth entry speed requirements when used as part of a round trip stopover mission. Charts, graphs and tabular data are included for total round trip mission duration and stopover time at Mars. The tabular trajectory data are for inbound and/or outbound swingbys that are projected for the 1975 through 1999 period; and stopover times are of zero, 30, and 60 day duration. Data are restricted to those missions which combine a direct leg and a ballistic Venus swingby leg, and mission employing Venus swingbys on both outbound and inbound legs. Minimum mission velocity requirements and associated earth entry speeds for each opportunity are presented as a function of mission duration for both propulsive braking and aerodynamic braking at Mars. M.W.R.

N68-30131# Manchester Coll. of Science and Technology (England). Dept. of Physics.
LABORATORY SIMULATION OF LUNAR LUMINESCENCE WITH SPECIAL REFERENCE TO METEORITIC MATERIAL Final Scientific Report, 15 Mar. 1964–14 Mar. 1967
John E. Geake, Michael D. Lumb, Christopher J. Derham, and Grahame Walker Dec. 1967 30 p refs
(Contract AF 61(052)-798)
(AFCRL-68-0235; AD-669327)

Apparatus is described for the irradiation of powdered rock samples with protons or UV radiation. The spectrum of any resulting luminescence emission is scanned by a photoelectric grating spectrophotometer. Material from meteorites of several different classes has been found to luminesce under proton excitation: UV radiation is relatively ineffective. The spectra of 20 of them are given and are found to be characteristic of the class of meteorite. The efficiencies fall into 3 groups, the most efficient being the enstatite achondrites at about 1%; these have a bright red emission peak at 6700A and a fainter blue one at 4000A. The enstatite constituent is responsible for the luminescence, but the emission may be predominantly red or blue depending on the manganese content. The spectrum has been reproduced using synthetic samples. Proton damage effects and recovery processes are discussed; spectral changes after damage are also characteristic of the class. The relevance of this type of luminescent material to lunar luminescence is discussed; thermoluminescence of the same type of material may be more relevant than directly excited luminescence. Author (TAB)

N68-30147*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
CATALOG OF PRECISELY REDUCED OBSERVATIONS
14 May 1968 175 p refs
(Grant NsG-87-60)
(NASA-CR-95872; SAO Special Rept.-275; P-17) CFSTI: HC $3.00/MF $0.65 CSCL 22C

Positions of artificial satellites as obtained by the Smithsonian Astrophysical Observatory from the precise reduction of films taken by 12 Baker-Nunn camera stations were catalogued for the period between October and December 1963. Each of the sets of data was checked and found to be without significant errors. Only orbits with a standard deviation of one observation not exceeding ±20″ were used as reference; on the average, the standard deviation was only between ±5″ and ±10″. All observations with residuals larger than ±10″ were examined to find whether the error was

due to the observation or to the poor accuracy of the orbit. Station coordinates and tesseral harmonics are presented in tabular form. M.W.R.

N68-30155*# Smithsonian Astrophysical Observatory, Cambridge, Mass.

THE DISTRIBUTION OF MAGNITUDES, MASSES, AND ENERGIES OF LARGE METEORIC BODIES

R. E. McCrosky 19 Jun. 1968 21 p refs

(Grant NsG-291)

(NASA-CR-95852; SAO-Special Rept.-280) CFSTI: HC $3.00/MF $0.65 CSCL 03

Eighty two Prairie Network meteors photographed between JD 2,439,000 and 2,439,500. Nearly all objects with $M \leq -9$ that occurred during that period are included. The photometric data permit a preliminary determination of the distribution function of magnitude, mass, and energy of bright meteors. The influx rate of the brightest objects is found to be high compared with the rate expected from an extrapolation of visual data. The mass influx, at the top of the atmosphere, exceeds that deduced from meteorite falls by 1 or 2 orders of magnitude. Author

N68-30166*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

SURVEYOR 3 MISSION REPORT. PART 3: TELEVISION DATA

Robert H. Steinbacher, Melvin I. Smokler, Richard Bideaux, and Stephen Z. Gunter 10 Nov. 1967 298 p refs

(Contract NAS7-100)

(NASA-CR-95875; JPL-TR-32-1177) CFSTI: HC $3.00/MF $0.65 CSCL 22A

Two hundred and thirty-two of the television pictures transmitted to earth from the lunar surface by Surveyor 3 are presented, and some mosaics composed of individual frames are also included. Camera description and calibration as well as mission performance are reviewed; and mention is made of the orientation of the camera with the lunar surface and sun, ground photo recording, and camera parameter information. Data for interpreting these representative pictures are included. M.W.R.

N68-30211# Joint Publications Research Service, Washington, D. C.

VENERA-4 MAGNETIC FIELD STUDY

Sh. Sh. Dolginov, Sh. Sh. Yeroshenko and L. N. Zhuzgov 2 Jul. 1968 28 p refs Transl. into ENGLISH from Kosmich. Issled. (USSR)

(JPRS-45830) CFSTI: HC $3.00/MF $0.65

Magnetic field data are analyzed which were taken from the USSR Venera-4 interplanetary space probe. Following an Earth–Venus trajectory the spacecraft collected data in the interplanetary region and in the near-planet region at a distance of between 31,000 and 200 km from the surface of Venus. Additionally, a preliminary result of interplanetary field characteristics in a period of considerable solar activity is presented. The space experiment is essentially a three-component ferroprobe magnetometer with an accompanying telemetry system. In the Earth–Venus trajectory the magnetic field measurements were correlated with observed solar disturbances, and reflected the 27-day intensity cycle associated with the sun's rotation. From analysis of data taken near Venus it is concluded: (1) The planet does not have a significant dipole nature. (2) It has a disturbing effect on the solar wind flowing past it. (3) The observed magnetic field in the near-planet trajectory is nontrivial. (4) Determination of variation of near-planet field distribution requires more extensive observations. D.H.B.

N68-30222*# Analytical Mechanics Associates, Inc., Cambridge, Mass. Boston Office.

MINIMUM IMPULSE GUIDANCE Interim Scientific Report

T. N. Edelbaum Jul. 1968 16 p refs

(Contract NAS12-114)

(NASA-CR-86073; Rept.-68-15) CFSTI: HC $3.00/MF $0.65 CSCL 22C

A linearized theory is developed for minimum fuel guidance in the neighborhood of a minimum-fuel space trajectory. The thrust magnitude is unrestricted so that the thrust is applied impulsively on both the nominal trajectory and the neighboring optimal trajectories. The analysis allows for additional small midcourse impulses as well as for small changes in the magnitude, direction, and timing of the nominal impulses. The fuel is minimized by determining the trajectory which requires the minimum total velocity change when summed over all the impulses. The analysis is deterministic and applies to arbitrary time-varying gravitational fields. Three separate time-open problems are treated, rendezvous, orbit transfer, and orbit transfer with tangential nominal impulses. Author

N68-30227

OPTIMIZATION OF THE ATMOSPHERIC RE-ENTRY CORRIDOR

E. R. Smol'iakov 1968 11 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 6, no. 1, 1968 p 49–57

CFSTI: HC $3.00/MF $0.65

Variational problems of atmospheric reentry confronting typical flying vehicles are analyzed. Maximum atmospheric reentry corridors and optimum control of the angle of attack and pitch within the corridor limits with an overload constraint are obtained on blunt cone type vehicles with a constrained angle of attack, and blunt plane type vehicles without an angle of attack constraint. S.C.W.

N68-30244*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

LUMINOUS EFFICIENCIES OF THREE NICKEL ARTIFICIAL METEORS BETWEEN 9.8 AND 11.4 KILOMETERS PER SECOND

T. Dale Bess Aug. 1968 24 p refs

(NASA-TN-D-4666; L-5774) CFSTI: HC $3.00/MF $0.65 CSCL 03B

Results of the experimental measurements of luminous intensity and corresponding luminous efficiency parameters of three nickel artificial meteors are presented. These results are compared with experimental values of iron luminous efficiencies over the same velocity range. All data were reduced from photographs taken with ground-based meteor cameras located at three camera sites. All flights were from Wallops Island, Virginia, and Nike-Cajun rocket vehicles were used to reenter the artificial meteoroids. Light curves on blue-sensitive film were obtained for all three nickel meteors, whereas the light curve on panchromatic film was obtained only for the fastest meteor. Data from the third experiment indicated that the radiation for this nickel meteor was strongest in the ultraviolet region of the spectrum; the measured blue-light intensity was about twice that of the panchromatic intensity. The experiments showed that the luminous efficiencies of nickel and iron are about the same at velocities around 11 and 12 kilometers per second; however, for lower velocities the luminous efficiency of nickel is as much as a factor of 10 less than the corresponding iron efficiencies. Author

N68-30254# California Inst. of Tech., Pasadena.

RESEARCH IN THE CIRCULATION OF THE SOLAR ATMOSPHERE Final Report, 9 Jun. 1966–19 Feb. 1968

Harold Zirin 19 Feb. 1968 13 p

(Grant NSF GA-526)

Instrumental work and observations of various sun phenomena by continuous cinematograms at two geophysical laboratories is described. Films of the solar atmosphere, obtained by pulse camera

with Halle H-α filter mounted on a Carroll telescope, show clearly the eruption of prominences on the solar disk and the flight of an arch type prominence across the disk and its landing on the surface at another point. The erupting prominence in this series appears bright against the disk rather than dark. Also observed are bright streams traveling back and forth between active regions.
G.G.

N68-30296 Royal Observatory, Edinburgh (Scotland).
THE ORIGIN OF THE PECULIAR A STARS
B. N. G. Guthrie 1968 24 p refs *Its* Publ., Vol. 6, No. 6
HMSO: 8s 6d

Well established abundance anomalies in peculiar A stars may be explained on a modified form of van den Heuvel's theory that peculiar A stars have been secondaries of binary systems with initial separations in the range 10 a.u. to 100 a.u. approximately. The primaries, initially earlier than spectral type B8, have evolved and exploded as type 2 supernovae. During the explosions, material enriched in heavy elements by interior nuclear reactions was transferred to the surfaces of the secondaries, which are now observed as peculiar A stars and are still on the main sequence. Excesses of Be and Si and deficiencies of O are caused by surface nuclear reactions on the secondaries after the explosions of the primaries. Mn stars differ from other peculiar A stars in many respects; the differences may be due to the primaries expanding beyond the Roche limits before they explode. On the oblique rotator theory, spectrum variables result from irregular distributions of surface nuclear reactions and ion migration on the secondaries. Some other theories of peculiar A stars are reviewed and shown to be in conflict with observation.
Author

N68-30303*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
MARINER MARS 1964 PROJECT REPORT: SCIENTIFIC EXPERIMENTS
R. K. Sloan 15 Jul. 1968 180 p refs
(Contract NAS7-100)
(NASA-CR-95876; JPL-TR-32-883) CFSTI: HC $3.00/MF $0.65 CSCL 22A

Discussions are presented for each of the six instruments and the measurements obtained from the fields and particles experiments of the Mariner Mars 1964 mission. The majority of the instruments performed well and all provided useful measurements enhancing the information on interplanetary space and on the near-earth and near-Mars environments. Specifically, the six instruments on the Mariner IV spacecraft measured: (1) trapped radiation dector—electron and proton radiation belts at earth and Mars and particle phenomena in interplanetary space; (2) cosmic dust detector—mass and flux distribution of interplanetary dust particles; (3) ionization chamber—average total ionization of high-energy particle radiation; (4) cosmic ray telescope—spectral energy analysis of high-energy cosmic and solar protons and α particles including directional variations; (5) helium magnetometer—magnitude and direction of planetary and interplanetary magnetic fields; and (6) plasma probe—density, velocity, and direction of charged particles making up the solar wind. Also included is the radio frequency occultation experiment using the spacecraft radio signal passage through the Martian atmosphere to determine characteristics of its atmosphere, specifically the density and intensity of the ionosphere, surface pressure, and scale height of the lower atmosphere.
Author

N68-30305# Grumman Aircraft Engineering Corp., Bethpage, N. Y.
ALBEDO AND PHOTOMETRY OF SURVEYOR FOOTPRINTS
John D. Halajian May 1968 26 p refs Presented at the 2d Am. Astronautical Sci. Meeting on Interpretation of Lunar Probe Data, Huntington Beach, Calif., Jan. 1968
(SAS-425-5)

The gray tone differences between the undisturbed lunar suface and the darker ejecta observed around Surveyor 1 footpads are reported. Albedo, (i.e. compositional differences between the surface and subsurface layers) or a mere difference of porosity between the undisturbed and disturbed materials are two reasonable hypotheses that have been suggested to account for the observations. These hypotheses are examined in the light of Surveyors 3, 5, and 6 data, and photometric studies of footprints in simulated lunar soils. While evidence favors the latter hypothesis, it is not conclusive. The author suggests that detailed data on the directional albedo (at or near opposition) of the Surveyor footprints could, in most cases, help discriminate between compositional and shadowing effects on the gray tones observed at large phase angles; also the area under normalized photometric curve can be used as a convenient index of surface porosity and, by inference, of packing density.
Author

N68-30315*# Stanford Research Inst., Menlo Park, Calif.
THE EFFECTS OF SHOCK WAVES ON METEORITES Final Report
J. Y. Wong and P. S. de Carli 30 Jun. 1968 64 p refs
(Contract NASr-49(24); SRI Proj. PGU-6105)
(NASA-CR-95873) CFSTI: HC $3.00/MF $0.65 CSCL 03B

Effects of shock waves on the iron and iron–nickel alloys in meteorites were analyzed by dynamic phase diagrams and studying the residual effects caused by the shock loading. An experimental method for determining the α–ϵ transition pressure of iron was studied. Since the ϵ-iron does not automatically revert to α-iron, it was concluded that a more conventional resistivity technique was better for studying dynamic temperature-pressure phase diagrams. A resitance heating technique for varying initial temperature of iron or iron–nickel alloy specimens used as piezoelectric elements was developed, as was a technique that uses the shock-induced transient demagnetization eddy current spike for monitoring the completeness of polymorphic transitions involving a magnetic phase. Samples of iron-2.5% silicon single crystals, the Karee Kloof coarse octahedrite, and the Hoba ataxite were shocked to pressures ranging from 35 to 480 kbar. Twinning occurred in the first two samples at 35, 70, and 90 kbar; and specimens pressured to 235 and 480 kbar showed the matte microstructure. Shock loaded Hoba specimens were marginally distinguishable from control specimens.
M.W.R.

N68-30359# Utrecht Observatory (Netherlands).
ONENESS OF THE UNIVERSE [L'UNITE DE L'UNIVERS]
M. Minnaert [1968] 12 p In FRENCH *Its* Publ. No. 49
CFSTI: HC $3.00/MF $0.65

A general discussion of the universe, its composition, and the role of man is presented; and note is made of various physical phenomena that occur and astronomical considerations. The relationship of astronomy, meteorology, geology, and biology to chemistry and physics is stressed, along with the oneness of the universe. The continuity of evolution is cited as an example.
Transl. by M.W.R.

N68-30422# Advanced Metals Research Corp., Burlington, Mass.
RESEARCH DIRECTED TOWARD THE ELECTRON MICROANALYSIS OF MINERAL PHASES IN CHONDRITE METEORITES Final Report, Sep. 1966–Sep. 1967
Donald M. Koffman and Robert E. Ogilvie 30 Sep. 1967 32 p refs
(Contract F19628-67-C-0029)
(AFCRL-67-0599; AD-669843)

The AMR Electron Beam Microanalyzer was employed to determine the variation in composition of the olivine and orthopyroxene (low calcium) compositions of twelve unequilibrated carbonaceous chondrites. These meteorites were found to exhibit a

range of homogeneity. The chemistry of the olivine, orthopyroxene and clinopyroxene in seventeen equilibrated ordinary chondrites of the H, L, and LL groups were determined, and the variation of chemistry within each group was found to be less than 4%, with the exception of the Shaw and Uden meteorites. These chondrites are atypical which is demonstrated by the higher Ca content of the orthopyroxene. Author (TAB)

N68-30454 Royal Observatory, Edinburgh (Scotland).
PHOTOGRAPHIC MEASURES OF THE POLARIZATION OF STARLIGHT IN h AND x PERSEI
N.M. Pratt 1968 122 p *Its* Publ. of the Roy. Obs., V. 6, No. 4, 1967 p 39–122
HMSO: £1 4s

A new photographic method is described for measuring the polarization of starlight using a polaroid filter which allows the simultaneous measurement of brightness differences not due to polarization effects. Overlapping of star images limits the use of the method to areas of sky with $\leq 6 \times 10^3$ stars per square degree. 527 stars in h and χ Persei to $V \leq 13$ have been measured. Using the stokes parameters, comparison with published photo-photoelectric measures for 54 stars gives an r.m.s. deviation of $\pm$ 0^m.029 per star, and the photoelectric and photographic means agree to within 0^m.003 and 1°. Stars with large proper motions have a smaller amount of polarization, and stars with $V > 12$ have a larger amount of polarization, but the position angle scarcely varies. Author

N68-30542# Joint Publications Research Service, Washington, D. C.
ASTRONOMY
In its Soviet-Bloc Res. in Geophys., Astronomy, and Space, No. 184 22 Jul. 1968 p 1–7 refs (See N68-30541 18-34)

Soviet-bloc news and abstracts of scientific articles are presented in the field of astronomy. The nature of pulsars, meteor observations, and photographs of Icarus are reported in news items. Abstracts deal with the theory of radio emission as related to Mercury, hypsometric levels of the lunar surface, isophotes of zodiacal light, and fireball radiation. Other topics are the shape of the moon, telluric lines and air mass, and fragment size characteristics of strong explosions. M.W.R.

N68-30601*# National Aeronautics and Space Administration, Washington, D. C.
PLANETARY ATMOSPHERES Continuing Bibliography with Indexes, Jun. 1966–Dec. 1967
Jul. 1968 126 p refs
(NASA-SP-7017(02)) CFSTI: HC$3.00/MF$0.65 CSCL 03B

Bibliographic citations and informative abstracts are presented on the properties of the atmospheres of Mars, Venus, Jupiter, Mercury, and Saturn, along with references to such related subjects as extraterrestrial environments, planetary observation techniques, and theories of planetary origin. Also included are subjects and personal author indexes. The bibliography covers the reports and journal articles announced in NASA abstract journals during the period June 1966 through December 1967. M.G.J.

N68-30687*# Smithsonian Astrophysical Observatory, Cambridge, Mass. Data Div.
SATELLITE ORBITAL DATA, NO. E-7
Beatrice Miller 15 May 1968 24 p
(Grant NsG-87-60)
(NASA-CR-95866; SAO Special Rept.-276; E-7; Rept.-803-105) CFSTI: HC$3.00/MF$0.65 CSCL 22C

Tabulated data are given on SAO mean elements, which were derived from precisely reduced observations covering several days. The effects of the short-period perturbations due to earth's oblateness were eliminated. The units of the orbital elements are degrees for angular quantities, megameters for linear quantities, and revolutions for the mean anomaly and its derivatives. Data are also included on the station coordinates, the values of the tesseral harmonics, values used in orbit calculation, and the zonal harmonics. B.S.D

N68-30726# Stanford Univ., Calif. Radioscience Lab.
RADIO ASTRONOMY RESEARCH Final Report, 27 Feb. 1964–31 Jan. 1968
R. N. Bracewell 25 Mar. 1968 20 p refs
(Contract AF 49(638)-1375)
(AFOSR-68-0530; AD-669927)

Radio astronomy research has been carried out in the fields of high resolution interferometry, radio polarimetry, solar activity, and galactic and extragalactic radio sources, details of which are given in a bibliography of references to scientific journals which is included. Design and construction commenced on a five-element array of 60-foot precision microwave paraboloids to have a beamwidth of 16 seconds of arc at a wavelength of 2.8 cm. The following reprints are appended: Stanford Radio Astronomy Institute, Astronomical J. v71 p941 1966; Stanford Radio Astronomy Institute, Astronomical J. v72 p1274 1967. TAB

N68-30777# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
OPTIMAL TRANSFERS BETWEEN CLOSE ELLIPTICAL ORBITS [TRANSFERTS OPTIMAUX ENTRE ORBITES ELLIPTIQUES PROCHES]
Jean-Pierre Marec 1967 255 p refs In GERMAN; ENGLISH summary *Its* publ. no. 121
CFSTI: HC$3.00/MF$0.65

The optimal rendezvous and transfers (minimum mass consumption for a given duration) between close elliptical orbits are analyzed in the case of propulsion systems characterized by a constant ejection velocity and a limited thrust; the performance obtained is compared to the performance of propulsion systems characterized by a modulable thrust and a limited power. The choice of the orbital elements as state components, added to the linearization hypothesis, leads to important simplifications (the adjoint vector is constant, in particular). This gives some general results concerning, among other things, the number of maximum thrust arcs per revolution, the singular cases when the linearized solution is not unique but degenerates into a large number of solutions and the "induction" phenomena (non-imposed variations of some orbital elements, induced by the imposed variations of the other orbit elements). The solution brings in the notion of "efficiency vector" or "primer vector" (indicating the direction of the optimal thrust), of "directrix orbit" (locus in the absolute axes reference system of the efficiency vector extremity originating at the mobile) and of "efficiency curve" (locus of this extremity in the rotating axes system). Author

N68-30810# Deutsche Forschungsanstalt fur Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugmechanik.
THEORY OF THE MOTION OF A MOBILE IN A CENTRAL GRAVITATIONAL FIELD IN CASE OF TANGENTIAL THRUST WITH APPLICATION TO THE BALLISTIC REENTRY INTO THE ATMOSPHERE [THEORIE DER BEWEGUNG EINES MOBILS IM ZENTRALKRAFTFELD BEI TANGENTIALSCHUB MIT ANWENDUNG AUF DEN BALLISTISCHEN EINTRITT IN DIE ATMOSPHAERE]
Ernst August Bockemueller Feb. 1968 60 p refs In GERMAN; ENGLISH summary
(DLR-FB-68-12) CFSTI: HC$3.00/MF$0.65

An analysis is made of the motion of a mass point in a central force field under the action of tangential thrust. A

relationship between the inclination angle of the trajectory and the velocity, both considered as functions of the altitude, is obtained, which is explicitely independent of the thrust function. With this statements on the local behavior of the trajectories may be obtained. With the assumption that the velocity slowly varies with altitude, approximate formulas are derived for the inclination angle, range and time history. The results of the analysis are employed to investigate the ballistic (non-lifting) entry into the earth's atmosphere. An analytic treatment of the so called intermediate phase is performed, where the aerodynamic deceleration and the gravitational acceleration are of the same order of magnitude. A relation for the inclination angle is derived and the region of validity is determined as a function of accuracy, the initial values and the constants of the vehicle. Author

N68-30814 Bolkow Entwicklungen K. G., Munich (West Germany).
TECHNOLOGICAL PROBLEMS OF A SOLAR PROBE TO 0.3 AU MINIMUM DISTANCE
Wolfram Schaefer and Dietrich E. Koelle [1968] 31 p refs Presented at the 18th European Space Symp., Venice, 27–29 May 1968
(RF-95-OE)

The experimental and electronic requirements for a solar probe with a perihelion of 0.3 AU are given. The natural environment of the interplanetary trajectory, in particular solar UV-radiation, solar wind, solar flares protons, are briefly described and integral radiation fluxes for a mission time of one year are estimated. Technological and material problems resulting from the close approach towards the sun and from space environment are described and analyzed. Solution possibilities and the present state of the art are discussed. Heat sheilds and insulations, booms and antennas, solar cell arrays, surfaces, and coatings as well as sun sensors are investigated in greater detail. Additional problems of thermal control and power supply arising in connection with the closer approach to the sun are shown and possible solutions discussed. Author

N68-30853# Illinois Univ., Urbana. Electrical Engineering Research Lab.
ATLAS OF LUNAR DATA. PLOTS OF IONOSPHERIC FARADAY ROTATION AND ELECTRON CONTENT VERSUS TIME. VOLUME 3: 1964
Harold D. Webb [1968] 353 p ref
(Contract DA-28-043-AMC-01710(E))
(AD-669624)

Volume III of the Atlas of Lunar Data contains plots of the Faraday rotation angle, Omega, and plots of electron content, eta, both plotted versus CST and LTASP, for the data obtained from January 1, 1964 through December 31, 1964. Seasonal averages of eta plotted versus LTASP, are also included. The material is presented as discussed in the Description of the Atlas of Lunar Data given in Volume I. The plots for the period January 1 through June 30, 1964 are relative. The plots for the period July 1 through December 31, 1964 are based on absolute values of Omega and eta. Author (TAB)

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N68-29598# Royal Aircraft Establishment, Farnborough (England).
THE SOLUTION OF A SATELLITE RE-ENTRY PROBLEM BY A GRADIENT TECHNIQUE
Dorothy N. Pullen Oct. 1967 18 p refs
(RAE-TR-67263) CFSTI: HC $3.00/MF $0.65

Use of gradient techniques is discussed for optimizing a control system defined by a set of first order ordinary differential equations. A satellite reentry problem is taken as an example. Author

N68-29640# Royal Observatory, Edinburgh (Scotland). Satellite Tracking Section.
STOPWATCH OBSERVATIONS OF SATELLITES. FEBRUARY 1968
R. D. Eberst 29 Apr. 1968 19 p
(ROE-STS-74) CFSTI: HC $3.00/MF $0.65

Stopwatch observations made at stations connected with the Section during the month of 1968 February are listed in satellite launch order and in time order for each satellite. Various sub-totals are given. ESRO

N68-29641# Royal Observatory, Edinburgh (Scotland). Satellite Tracking Section.
STOPWATCH OBSERVATIONS OF SATELLITES: JANUARY 1968
R. D. Eberst 22 Apr. 1968 16 p
(ROE-STS-73) CFSTI: HC $3.00/MF $0.65

Stopwatch observations made at stations during the month of 1968 January are listed in satellite launch order and in time order for each satellite. Various sub totals are given. Author (ESRO)

N68-29644# Centre National d'Etudes Spatiales, Paris (France).
SCIENTIFIC DEFINITION OF THE FR-2 SATELLITE PROJECT (EOLE PROJECT) [DEFINITION SCIENTIFIQUE DU PROJET DE SATELLITE FR-2 (PROJET EOLE)]
P. Morel Jul. 1967 40 p refs In FRENCH Presented at the 10th General COSPAR Meeting, London, Jul. 1967
CFSTI: HC $3.00/MF $0.65

The FR-2 satellite project constitutes an attempt to associate a spacecraft with a network of ground stations for in situ measurement of tropospheric data. Physical parameters (pressure, temperature, wind velocity) are measured aboard constant level balloons. These data are collected by an orbiting satellite and broadcast to a ground station together with the position of the balloons. The horizontal sounding system envisaged is described. The level of the balloons and the influence of altitude errors as well as launching and spatial distribution of balloons are discussed. Scientific aims and future developments of the experiment are indicated. ESRO

N68-29645# Royal Aircraft Establishment, Farnborough (England).
THE IN-ORBIT THERMAL PERFORMANCE OF THE ARIEL 3 SPACECRAFT. PART 1: MAY-SEPTEMBER 1967
E. C. Semple Oct. 1967 19 p refs
(RAE-TR-67253) CFSTI: HC $3.00/MF $0.65

Temperatures measured on the Ariel III spacecraft during its first four months in orbit are presented, and a comparison is made with the temperatures predicted before launch. Author (ESRO)

N68-29654# European Space Research Lab., Noordwijk (Netherlands).
MEASUREMENTS OF ION DENSITIES IN THE D-REGION OF THE IONOSPHERE WITH ROCKET PROBES
A. Pedersen Paris ESRO Feb. 1968 25 p refs Jointly sponsored by NAS-NRC
(ESRO-SN-89) CFSTI: HC $3.00/MF $0.65

The principle of a Gerdien condenser ion collector is explained and its limitations, due to air flow conditions, plasma sheaths and photo-effects, are discussed for the cases where it is flown on a rocket or with a parachute. Various types of probes, and the results obtained with them, are described. It is argued that ion densities obtained by parachuted probes are reliable between approximately 40 and 75 km, whereas results from probes flown on rockets are more difficult to interpret. The possibility of developing a mobility spectrometer is discussed and it is concluded that there is little hope of achieving a fine-scale identification of ion masses from mobility measurements. Author (ESRO)

N68-29658# Royal Observatory, Edinburgh (Scotland). Satellite Tracking Section.

STOPWATCH OBSERVATIONS OF SATELLITES: DECEMBER 1967

R. D. Eberst 25 Mar. 1968 25 p refs

(ROE-STS-72) CFSTI: HC$3.00/MF$0.65

Stopwatch observations made at stations connected with the Section during the month of 1967 December are listed in satellite launch order and in time order for each satellite. Various sub-totals are given. Author (ESRO)

N68-29764*# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.

INVESTIGATION OF A HOPPING TRANSPORTER CONCEPT FOR LUNAR EXPLORATION

Marshall H. Kaplan and Howard S. Seifert Jun. 1968 215 p refs

(Grant NGR-05-020-258)

(NASA-CR-95810; SUDAAR-348) CFSTI: HC$3.00/MF$0.65

An investigation was conducted in which the performance characteristics of a hopping transporter were determined by studying the dynamic characteristics of idealized hopping vehicle configurations. Two schematic designs were investigated. These include (1) a single-man device assumed to be of minimum complexity and mass, transportable with Apollo crews, and (2) a multi-man transporter capable of making long range and duration explorations of the lunar surface. Attention was focused on factors which affect transporter design and operation, definition of performance limiting phenomena, development of general operating constraints and functions, derivation and solution of equations of motion for each vehicle design studied, and calculation of hop performance data based on digital computer simulations of vehicle dynamics. Results indicate that hopping vehicles offer superior performance capabilities for lunar surface mobility. B.S.D.

N68-29871*# General Precision, Inc., Little Falls, N. J. Aerospace Research Center.

DESIGN OF A THREE-AXIS ATTITUDE CONTROL SYSTEM FOR A SPACECRAFT ACTED UPON BY RANDOM PERTURBATIONS Final Report

B. Friedland, F. E. Thau, and P. E. Sarachik Apr. 1968 112 p refs

(Contract NAS12-48)

(NASA-CR-86072) CFSTI: HC$3.00/MF$0.65 CSCL 22C

The design of spacecraft attitude control systems to counteract the effects of random excitations such as induced by micrometeroid bombardment is an important problem in achieving the high pointing accuracy required for projected advanced missions, including a laser beam communication system. The general problem of optimizing the design for a nonlinear system with an arbitrary statistical performance criterion has not been completely solved. In this investigation, the process to be controlled (a hypothetical laser communication vehicle) was linearized about a nominal motion and the design performance criterion was the steady-state expected value of a quadratic form in the vehicle state-variables. Use of this performance permits use of known results to develop a design algorithm for the three-axis attitude control system. This design algorithm is employed to determine the structure and parameter values of the controller for the vehicle and the statistical performance is simulated with the aid of a digital computer simulation program. The results obtained indicate that it is possible to achieve a 1σ pointing accuracy of approximately 0.2 sec in the assumed micrometeoroid environment existing in the vicinity of Mars. This pointing accuracy can be maintained only for about 20 minutes (as measured in "half-life"). Author

N68-29962*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

EXPERIMENTAL INVESTIGATION OF THE USE OF SOFT SIDE LEGS TO IMPROVE TOUCHDOWN STABILITY OF LEGGED LANDING VEHICLES

Robert W. Herr Washington Aug. 1968 23 p refs

(NASA-TN-D-4680) CFSTI: HC$3.00/MF$0.65 CSCL 22B

The effectiveness of a concept to improve the landing stability of lunar-module-type vehicles has been investigated experimentally by utilizing a 1/6-scale model of an early engineering version of the lunar module. Results of landing-stability tests made with equal-force shock absorbers in all four leg assemblies are compared with results obtained with very soft shock absorbers in the side legs. This comparison indicates that landing stability can be greatly improved with the use of soft side struts if the fore and aft feet are roughly alined with the flight path at touchdown. For touchdowns at large yaw angles, the landing stability with soft side shock absorbers was at least as good as that obtained with equal-force shock absorbers. Author

N68-29993*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

FLIGHT TEST OF A 40-FOOT-NOMINAL-DIAMETER DISK-GAP-BAND PARACHUTE DEPLOYED AT A MACH NUMBER OF 2.72 AND A DYNAMIC PRESSURE OF 9.7 POUNDS PER SQUARE FOOT

Clinton V. Eckstrom and John S. Preisser Washington Aug. 1968 41 p refs

(NASA-TM-X-1623) CFSTI: HC$3.00/MF$0.65 CSCL 22B

A 40 foot nominal diameter (12.2 meter) disk-gap-band parachute was flight tested as part of the NASA Supersonic Planetary Entry Decelerator (SPED-1) Program. The test parachute was deployed from an instrumented payload by means of a deployment mortar when the payload was at an altitude to 158,500 feet (48.2 kilometers), a Mach number of 2.72, and a free stream dynamic pressure of 9.7 pounds per foot^2 (465 newtons per meter^2). Suspension line stretch occurred 0.46 second after mortar firing and the resulting snatch force loading was -8.1g. The maximum acceleration experienced by the payload due to parachute opening was -27.2g at 0.50 second after the snatch force peak for a total elapsed time from mortar firing of 0.96 second. A calculated average nominal axial force coefficient ranged from about 0.25 immediately after the first canopy opening to about 0.50 as the canopy attained a steady inflated shape. Although the canopy damage caused by the deployment bag penetration had no apparent effect on the functional capability of the test parachute, it may have affected parachute performance since the average effective drag coefficient of 0.48 was 9 percent less than that of a previously tested parachute of the same configuration. Author

N68-29995*# Boeing Co., Seattle, Wash.

LUNAR ORBITER 3: EXTENDED-MISSION SPACECRAFT OPERATIONS AND SUBSYSTEM PERFORMANCE

Washington NASA Jul. 1968 128 p

(Contract NAS1-3800)

(NASA-CR-1109; D2-100753-4) CFSTI: HC $3.00/MF $0.65 CSCL 22B

This report covers spacecraft control and flight path analysis and control operations conducted during the Lunar Orbiter 3

extended mission and discussed spacecraft performance during these operations. Complete data packages have been prepared for each experiment. The highlights of each special exercise and experiment are summarized. The primary objective of the Lunar Orbiter 3 extended mission was to secure information that may be used to increase the scientific knowledge of the size and shape of the Moon, the properties of its gravitational field, and the lunar environment. Secondary objectives were to conduct special exercises to determine the limits of spacecraft capabilities, develop standard operating procedures, conduct experiments to provide additional scientific data, and explore the use of Lunar Orbiter subsystems for other applications. Author

N68-30032*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

A QUASI-STEADY STATE ANALYSIS OF THE DYNAMIC BEHAVIOR OF A CONIC BODY MOVING IN A NONUNIFORM WAKE

John De Fife and Theodore F. Hughes (ITT/Federal Elec. Corp.) Washington Aug. 1968 57 p refs

(NASA-TN-D-4691) CFSTI: HC$3.00/MF$0.65 CSCL 22C

During reentry, the Apollo command module creates a wake of turbulent and reverse-flow conditions. When the earth-landing-system protective cover (forward heat shield) of the command module is jettisoned and moves within this wake, the kinetic energy of the cover is substantially reduced because of the reverse flows. Equations were developed which allowed vectorial additions of wake velocities to those velocities of the forward heat shield. From these resultant vectors and from wind-tunnel aerodynamic data, forces and accelerations were calculated, and trajectories were generated which indicated that the reverse flows within the wake had a significant effect on the dynamic behavior of the protective cover and therefore caused recontact for low initial separation velocities. Author

N68-30064

EXPERIMENT ON MAINTENANCE OF THE LOW TEMPERATURES ASSURING THE OPERATION OF SUPERCONDUCTING SYSTEMS UNDER ORBITAL FLIGHT CONDITIONS

O. P. Anashkin, B. M. Belitskii, V. B. Brodskii, L. V. Kurnosova, N. N. Mikhailov et al [1968] 13 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 6, no. 1, 1968 p 132–143

CFSTI: HC$3.00/MF$0.65

Results of an experiment verifying the possibility of superconducting units operating on board space vehicles are expounded. Helium at a 2.4 atm pressure (initial temperature, 5.2°K) was used as a coolant. The temperature was checked in flight at six points of the helium container; the pressure in the container, and the magnetic field intensity in two short-circuited superconducting solenoids were also checked. As a result of the measurements, it has been established that such a method of assuring low temperatures may successfully be used under weightlessness conditions. Author

N68-30070*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

AIMP-D THERMAL DESIGN REPORT

S. Ollendorf Jul. 1968 34 p refs

(NASA-TM-X-63282; X-713-68-234) CFSTI: HC $3.00/MF $0.65 CSCL 22B

The primary objective of the AIMP-D spacecraft was to investigate, in the vicinity of the moon, the characteristics of the interplanetary magnetic field, solar plasma flux, dust distribution, solar and galactic cosmic rays, as well as to study the magnetohydrodynamic wake of the earth in the interplanetary medium at lunar distances every 29.5 days. The launch vehicle for the mission was the thrust augmented improved Delta with an FW-4 third stage. The retro-motor was used to slow the spacecraft to permit its capture by the lunar gravitational field. Author

N68-30096*# International Business Machines Corp., Houston, Tex. Federal Systems Div.

PROJECT GEMINI FINAL REPORT—SUMMARY

[1968] 54 p ref

(Contract NAS9-996)

(NASA-CR-92180) CFSTI: HC$3.00/MF$0.65 CSCL 22A

The Real Time Computer Complex (TRCC) developed for the Gemini and Apollo projects is reviewed in this Gemini Project final report. The RTCC consisted of the Mission Operational Program (MOP) System, the Ground Support Simulation Computer (GSSC) System, and several small operational systems. The MOP used during the Gemini 12 is detailed, including the control programs that were used to achieve the integration of the subsystems during the various mission phases. A 1/2-million word real time program, MOP monitored telemetry and radar inputs from around the world and responded to the manual requests of flight controllers at the Mission Control Center. The GSSC program was part of the Simulation, Checkout, and Training System (SCATS) designed to provide simulations of Gemini missions for training MOP control teams, remote site teams, and the astronauts. Also discussed are the RTCC computers and associated equipment to provide data processing and to interface with real time input, output, and display systems. This equipment was used to support mission and simulation functions as well as to develop programming systems. Development, management, support, and operations aspects of the overall program are considered. M.W.R.

N68-30149*# West Virginia Univ., Morgantown.

THERMAL CONTROL CHARACTERISTICS OF A DIFFUSE BLADED SPECULAR BASE LOUVER SYSTEM Final Report

H. W. Butler, J. F. Parmer, E. A. Stipandic [1967] 58 p refs

(Grant NGR-49-001-014)

(NASA-CR-95870) CFSTI: $3.00 CSCL 22B

Movable shutters or louvers systems have been successfully flown on a number of spacecraft missions to ensure temperature control of the spacecraft. Highly polished metallic louver blades mounted over a diffuse white faceplate are now state of the art. However, it was decided to investigate the thermal characteristics of a new configuration incorporating diffuse metallic blades mounted over a specular high solar reflecting base surface. The investigation includes an analytical determination of all heat transfer characteristics of a louver system operating in full sunlight. This analysis is made with the assumption that definite surface areas of illumination exist on the diffuse blades due to either direct solar impingement or a specular reflection from the base surface. The radiosity approach is used in first writing a solar flux balance and solving for all thermal properties associated with the solar region. A heat balance is then used to determine the terrestrial properties of the system. The solar and terrestrial properties are then superimposed resulting in the determination of the thermal control characteristics of the system. Author

N68-30152*# Honeywell, Inc., Minneapolis, Minn.

STABILIZATION AND CONTROL SYSTEM POWER SENSITIVITY STUDY

William C. Clemmens, Leif N. Dahl, Otto L. Jourdan, Joseph A. Miller, Gordon L. Seller, et al Jun. 1968 100 p refs

(Contract NAS12-633)

(NASA-CR-86085; REPT.-21031-FR) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Sensitivity of Stabilization and Control System (SCS) reliability to the power-off failure rate was studied using the Apollo guidance and control system as a model for developing the methodology for future power distribution systems. Block power switching was analyzed, and failure rate determinations were made. Specific

penalties resulted from power distribution on a block power switching basis, and about 23% of the failures during the 5000 LLM (Lunar Landing Mission) simulations were attributed to equipment that was energized but not required at the time of the failure. A vendor information survey indicated the significance of power-off cycling. Computer analysis indicated that for the simulated mission considered, the use of nonoperating failure rates did not significantly affect system reliability. Analysis of an alternate configuration, however, indicated that nonoperating failure rates could be significant if sufficient quantities of unused equipment can be shut off. M.W.R.

N68-30156# Weapons Research Establishment, Salisbury (Australia).
A FORTRAN 2 COMPUTER PROGRAM FOR STEADY STATE AEROELASTIC EVALUATION OF SLENDER NON-ROLLING ROCKET VEHICLES
A. R. Glasson and K. G. Pearson Oct. 1967 54 p refs
(WRE-TN-HSA-128) CFSTI: HC $3.00/MF $0.65

The computer program is used to calculate design loads and divergence dynamic pressure for non-rolling flexible vehicles. A listing and a description of the program are presented, together with the analysis on which the program is based. Mass, stiffness, and aerodynamic body lift are treated as distributed quantities. Fin lifts are treated as point loads and include the effects of downwash. Author

N68-30193# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
DERIVATION OF OAO COARSE POINTING MODE MODEL IN STATE VARIABLE FORM
Art Chomas and Gunther R. Geiss Jun. 1968 39 p refs
(RM-415)

The Orbiting Astronomical Observatory is a high precision attitude controlled structure which can accommodate various astronomical experiment packages. The attitude control system operates in four fundamental modes: the initial acquisition of the sun line and then the guide stars; the open loop slewing from one commanded attitude to another; the coarse pointing mode in which attitude errors are reduced to levels acceptable to the fine sensors; and then the fine pointing mode. This memorandum is concerned with the stability analysis of the coarse pointing mode. In this mode, star trackers are the attitude sensors, and the control actuators are a set of momentum wheels which are unloaded, when required, by a set of gas jets. Presented is the derivation of the state equations for the present configuration of the coarse pointing mode. The exact linearization of these equations is determined, and shown to be a function of the equilibrium (offset Euler angles). The offset is shown to be dependent on the initial system momentum and the functional relationship between initial momentum and offset is then estimated. Author

N68-30223*# Quantic Industries, San Carlos, Calif. Electro-Optical Div.
DESIGN AND TEST OF AN EARTH ASPECT SENSOR
Harold A. Elliott and Jack C. Heffington [1968] 175 p refs
(Contract NAS2-3281)
(NASA-CR-73221; ETD-261) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Designed for a class of missions in which a spin-stabilized probe leaves the immediate vicinity of the earth and enters a solar probe, an earth aspect sensor (EAS) was developed in electronic breadboard form for measuring the angle between the vehicle spin axis and the line of sight to the earth. The outputs can be used either for vehicle attitude control or for attitude measurement in conjunction with payload experiments. After studying the radiation characteristics of the earth and other planets that could be bright enough to interfere with EAS operation, the visible region (0.3 to 1.0μ) and target discrimination by means of color were selected as a basis for the design. Evaluations of optical and electronic concepts led to the selection of an optical system based on measurement of the width of the earth pulse and using solid-state silicon photovoltaic detectors, combined with a spin-coherent electronic signal processing system with digital integration. Preliminary testing of the breadboard demonstrated that the EAS is capable of searching for and locking on the earth at ranges up to 50 million miles with an accuracy of ±1/2° and a field of view of ±15°. M.G.J.

N68-30281*# University of Southern Calif., Los Angeles. Electronic Sciences Lab.
FUEL OPTIMUM STOCHASTIC ATTITUDE CONTROL
Robert B. McGhee, H. J. Payne, and William H. Spuck, III Feb. 1968 114 p refs
(Grant NGL-05-018-044)
(NASA-CR-95882; USCEE-250) CFSTI: HC $3.00/MF $0.65 CSCL 22B

The design of fuel optimum, position and thrust constrained, randomly disturbed spacecraft attitude control systems is a continuing engineering problem. A closely related problem is one in which velocity is directly controllable (here called an antenna steering problem). In their simplest form these problems are easily reduced to those of minimizing the fuel expended to maintain a given position. Among the many potentially useful methods of approaching these optimum control problems, that based on Hamilton-Jacobi Theory is pursued here. The Hamilton-Jacobi type equation for the disturbance free system is well known. A similar equation for the stochastic case is presented in this study. The deterministic Hamilton-Jacobi equations for the problems under study here are solved analytically and are valid for all states and times to go. A steady state analytic solution for a stochastic case is presented in this study, but the time dependent problem is found to be analytically intractable. As a result, the stochastic cases are solved approximately using numerical techniques. Author

N68-30586# Navy Dept., Washington, D. C.
HEAT PROTECTION FOR SPACE SHIPS [TEPLOZASHCHITA KOSMICHESKIKH KORABLEI]
A. Savchenko and F. Gimranovs 17 May 1968 7 p Transl. into ENGLISH from Aviats. i Kosmonavt. (Moscow), no. 3 p 30–33
(TRANS-2602; AD-669992)

The document discusses various modes of protecting space ships during reentry of the earths atmosphere following the conclusion of space missions. TAB

N68-30572*# Sperry Rand Corp., St. Paul, Minn. UNIVAC Federal Systems Div.
STRAPDOWN CALIBRATION AND ALIGNMENT STUDY. VOLUME 2: PROCEDURAL AND PARAMETRIC TRADE-OFF ANALYSES DOCUMENT Final Report
D. M. Garmer, E. J. Farrell, and D. E. Jones [1968] 119 p refs
(Contract NAS12-577)
(NASA-CR-86078) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Calibration procedural and parametric tradeoff studies are detailed for a strapdown inertial sensing unit (ISU), and calibration time versus calibration accuracy are treated in terms of quantization errors, noise errors, and bubble level compensation. Alignment tradeoffs and alignment time versus alignment accuracy for worst-case quantization are considered. A basic measure of alignment errors is developed that is related to errors in estimates for four orientation cases for both level and gyrocompass alignment. Statistics of this basic measure are developed in terms of the statistics in the estimate. Effects of noise, quantization, and computer word length upon alignment accuracy determined by a Monte Carlo simulation are given; and the effect of calibration accuracy on

alignment accuracy is reported. Noise equations relating coefficient errors to sensor noise output for both gyros and accelerometers are detailed, and geometrical effects and the statistics of the sensor output for both are discussed. M.W.R.

N68-30620# Royal Aircraft Establishment, Farnborough (England).
CECLES LAUNCHER: EUROPE 1 F.5 VEHICLE LAUNCHING OF 15TH NOVEMBER 1966, SECOND STAGE [LANCEUR CECLES: EUROPE 1 VIHICULE F.5 TIR DU 15 NOVEMBRE 1966. RAPPORT DEFINITIF SUR LE DEUXIEME STAGE]
Final Report
Dec. 1967 99 p Transl. into ENGLISH from Nord Aviation Rept. 112/67 (France)
(RAE-LIB-TRANS-1271) CFSTI: HC $3.00/MF $0.65

The evaluation of the 2nd stage performance of the ELDO launching vehicle was reported. The analysis of the trials objectives and ground support for the second stage of the F.5 vehicle form the basis of these reports, and in the main the category I objectives were achieved apart from some loss of telemetry signals and transient faults in the equipment. The category II objectives were also achieved apart from minor electrical faults. The records of the important separation phase between the first and second stages showed that the vehicle behaved as predicted although there was telemetry signals loss because of flame attenuation. The main troubles encountered during the progress of the launch were the failures to receive information by the telemetry and the lack of personnel acquainted with the problems especially ground equipment faults. Author

N68-30631*# Boeing Co., Seattle, Wash.
LUNAR ORBITER 5. EXTENDED-MISSION SPACECRAFT OPERATIONS AND SUBSYSTEM PERFORMANCE
NASA Aug. 1968 121 p
(Contract NAS1-3800)
(NASA-CR-1142; D2-100755-4, V. 4) CSCL 22 A

The Lunar Orbiter V spacecraft was tracked from the start of its extended mission on August 28, 1967 until it was intentionally crashed into the moon's nearside on January 31, 1968. During this period, the primary objectives of selenodetic data acquisition and lunar environment sampling were accomplished by ranging, tracking, and spacecraft telemetry monitoring. Included here are also descriptions of the spacecraft's flight and guidance control systems, and data on the performance of its subsystems. Author

N68-30753# Lincoln Lab., Mass. Inst. of Tech., Lexington.
STABLE EQUILIBRIUM ORIENTATION OF A SPACECRAFT WHICH CONTAINS A MOMENTUM WHEEL
John U. Beusch 10 May 1968 32 p refs Supersedes ESD-TR-67-164; See N67-28243
(Contract AF 19(628)-5167)
(TN-1967-16, Rev. 1; ESD-TR-68-86; ESD-TR-67-164; AD-669806)

The orientation of a spacecraft when it is in a stable equilibrium state is studied. The spacecraft contains a single momentum wheel which stores angular momentum. The axis of the wheel is not necessarily parallel to a principal axis of the spacecraft. For an arbitrary but fixed speed of the wheel relative to the spacecraft body, it is shown that there may be one, two, or three stable equilibrium points. At each of these points, the body may spin about an axis which is fixed in both spacecraft and inertial coordinates. The orientation of this axis in spacecraft coordinates can be determined from expressions in this report. A threshold can be determined such that, if the speed of the wheel relative to the spacecraft is larger than this threshold, there is only one stable equilibrium point. This information can be used to determine the eventual orientation of the spacecraft provided it is designed such that, if it becomes seriously misoriented, the momentum wheel drive motor automatically holds the wheel speed to a predetermined value. Author (TAB)

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N68-29567#
BUCKLING OF AXIALLY COMPRESSED CYLINDRICAL SHELLS WITH INITIAL DEFLECTIONS
G.V. Ivanov [1968] 4 p refs Transl. into ENGLISH from Prikl. Mekh. (USSR), v. 4, no. 2, 1968 p 63-66
CFSTI: HC $3.00/MF $0.65

Nonsymmetric initial deflections relative to the shell axis are shown to have as much influence as axisymmetric deflections during the study of initial deflections on the loading dependence of axial deformations of a shell. Geometric linear theory is used for determining the subcritical states of a shell with nonsymmetric initial deflections; and strain compatibility for these equations is found, the Galerkin method is applied to the equilibrium equation, and the connection between the axial strain and the loading and deflections components is shown. Critical loading was found to be exaggerated when the initial deflections were as large as 0.4 and when geometrically linear theory was used to determine subcritical states. M.W.R.

N68-29580
CREEP OF NONSYMMETRICALLY HEATED TUBES SUBJECTED TO INTERNAL PRESSURE
I. A. Daniushevskii [1968] 3 p refs Transl. into ENGLISH from Inzh. Zh., Mekh. Tverd. Tela (USSR), no. 1, 1968 p 135-137

Steady creep of a nonsymmetrically heated tube subjected to internal pressure is considered. It is assumed that the tube is in the plane strain state. The tube material in the steady creep state is subject to the flow law. The problem reduces to minimizing a nonquadratic functional. The solution is obtained by a modified Ritz method. The calculations were made on the "Ural-2" computer. For small deviations of the temperature field from the axisymmetric, the results are in good agreement with the analytical solution. An analytic solution of the problem of steady creep of a nonuniformly heated thick-walled tube under internal pressure has been obtained for the case of almost axisymmetric temperature fields. The solution of this problem is elucidated in the general case of a nonuniform temperature field by a modified Ritz method. Author

N68-29581
CREEP OF A CYLINDRICAL TUBE SUBJECTED TO THE COMBINED EFFECT OF INTERNAL PRESSURE, AXIAL FORCE, AND TORQUE
M. A. Zadoian [1968] 3 p refs Transl. into ENGLISH from Inzh. Zh., Mekh. Tverd. Tela (USSR), no. 1, 1968 p 137-140

Steady creep of a long thick-walled cylindrical tube under the combined effect of internal pressure p, axial force N, and torque M is considered. A solution is obtained of the equations of steady state creep theory, when the strain rate tensor depends only on the radial coordinate r. On the basis of this solution, a solution is constructed for the posed problem. Author

N68-29591# Battelle Memorial Inst., Columbus, Ohio.
SPALL FRACTURE AND DYNAMIC RESPONSE OF MATERIALS
John H. Oscarson and Karl F. Graff Mar. 1968 132 p refs
(Contract DA-49-083-OSA-3176; ARPA Order 197)
(BAT-197A-4-3; AD-669440)

The report describes the time-dependent fracture, or spalling, of materials as a result of dynamic response to shock-wave or impulse loading. From stress-wave and fracture-mechanics theory and assuming knowledge of the dynamic properties of the material, theories are developed to predict the stress at the spall plane. The cumulative, energy, stress-rate, and bond-breaking models for the prediction of spall fracture are described, along with the basic criteria of each model. Author (TAB)

N68-29607
ON TAKING ACCOUNT OF THE LOADING SEQUENCE AND SCALE FACTOR IN ESTIMATING THE STRENGTH OF BRITTLE SOLIDS UNDER COMPLEX COMPRESSIVE AND TENSILE LOADING
A. I. Markov, N. V. Mikhailov, and P. A. Rebinder [1968] 4 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 179, no. 5, Apr. 1968 p 1079–1082
CFSTI: HC $3.00/MF $0.65

Several techniques used in cited works of other authors are reviewed in order to elucidate the applicability of various theories of strength to the estimation of the stress state of solids, particularly concrete. Test data on the strength of such solids under simple and complex compressive and tensile loading are critically evaluated for factors affecting approximation and for functional dependences. K.W.

N68-29611
THERMOPLASTICITY PROBLEM FOR A SHALLOW SHELL OF REVOLUTION
V. I. Makhnenko and E. A. Velikoivanenko [1968] 8 p refs Transl. into ENGLISH from the book "Thermal Stresses in Structural Elements" Kiev, Naukova Dumka, no. 7, 1967 p 57-64
CFSTI: HC $3.00/MF $0.65

The process of development of thermoplastic strains and stresses in a variable thickness shell whose middle surface is formed by rotation of an arbitrary shallow curve around the x axis is considered. The shell is loaded symmetrically to the x axis by a surface loading and a nonstationary temperature field which varies arbitrarily along the shell thickness and axis. The problem is set up to be solved on an electronic computer; hence, the following assumptions are made: The influence of dynamic effects associated with the nonstationarity of the loading can be neglected; the fundamental geometric and power hypotheses of thin shells are valid; the shell material corresponds to the physical model of a Prandtl-Reiss body under Mises fluidity conditions; the yield point of the material is a known function of the temperature, or a known function of the coordinates x,z and the time t for given T(x,z,t); the elastic characteristics are constant. Author

N68-29618 Rensselaer Polytechnic Inst., Troy, N. Y.
SOME PROBLEMS IN NONHOMOGENEOUS ELASTICITY
Richard Douglas Schile (Ph. D. Thesis) 1967 58 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-12844

Three problems were considered in this investigation: (1) The axi-symmetric deformation of a thin, elastic circular plate with elastic properties variable both over the radius and through the thickness. (2) The axi-symmetric deformation of a thin circular plate with elastic properties variable only over the thickness. (3) The plane stress distribution in a thin beam having elastic properties variable over the depth of the beam, loaded along one edge by a polynomial load distribution and at the end by arbitrary forces and moments. The procedure used in Problem (1) involved the expansion of all stresses and elastic functions in power series over the thickness of the plate, followed by asymptotic solution of the relevant equations. In Problem (2), the elastic properties were allowed to vary in an arbitrary manner over the thickness of the plate. These solutions were found to be exact when the plate was loaded only by forces and moments applied at the edges. An exact solution to Problem (3) was obtained for the case in which the beam was loaded by an arbitrary polynomial load distribution of degree N along the span and by arbitrary forces and moments at the end. The elastic properties were allowed to vary. Dissert. Abstr

N68-29627 Delaware Univ., Newark.
THEORETICAL ANALYSIS OF RECTANGULAR ISOTROPIC AND ORTHOTROPIC LAMINATED PLATES
George Dewees Summers (Ph.D. Thesis) 1966 203 p
Available from Univ. Microfilms: HC $9.25/MF $3.00 Order No. 67-11738

The individual plate equations are developed from the three dimensional equations for thin isotropic and orthotropic laminae. Utilizing the Reissner variational theorem in elasticity, plate equations are developed for moderately thick isotropic and orthotropic laminae. Each individual set of plate equations is derived for a normal and shear stress loading on the surface. By matching displacements and stresses at the interfaces, three sets of plate equations are combined to produce laminated plate equations for (a) a laminated plate with three thin isotropic laminae, (b) a sandwich plate with thin isotropic faces and a moderately thick isotropic core, (c) a laminated plate with three moderately thick isotropic laminae, (d) a laminated plate with three thin orthotropic laminae, and (e) a sandwich plate with thin orthotropic faces and a moderately thick orthotropic core. Numerical examples are presented which demonstrate the utility of the various methods of solution. Dissert. Abstr.

N68-29630
SMALL ELASTOPLASTIC DEFORMATIONS OF PLATES AND SHELLS
V. I. Korolev 1968 8 p refs Transl. into ENGLISH from Prikl. Mekh. (USSR), v. 4, no. 4, 1968 p 16–24
CFSTI: HC $3.00/MF $0.65

A method is proposed for the solution of plasticity problems for thin plates and shells fabricated from materials with slight linear strengthening. The solutions are based on the A. A. Il'iushin relationships, and use of a small parameter. The effectiveness of the method is illustrated in an example of a circular plate subjected to uniform external pressure. Author

N68-29632# National Aeronautical Establishment, Ottawa (Ontario).
VIBRATION MODES AND RANDOM RESPONSE OF A MULTI-BAY PANEL SYSTEM USING FINITE ELEMENTS
Garry M. Lindberg and Mervyn D. Olson Dec. 1967 88 p refs
(LR-492; AD-669294)

A finite element approach to the dynamic analysis of continuous skin-stringer panels is presented. The method is illustrated in the calculation of vibration modes and random response of a five-bay stringer-stiffened panel with all outer edges clamped. The panel skin is represented by finite plate elements and the stringers, which are assumed infinitely stiff in bending, are represented by beam torsional elements. Results are presented for the first 36 panel vibration modes. These modes occur in distinct groups with five similar modes in each, the number five corresponding to the number of panel bays. The response of the panel to plane wave propagation of acoustic noise (propagating normal to the stringers) is also calculated. The resulting response power spectral densities

were found to be fundamentally different from those associated with single span panels. These power spectra did not have widely separated peaks, but rather the peaks tended to be squeezed into groups corresponding to the groupings of natural frequencies for the panel. Author (TAB)

N68-29647
APPROXIMATE METHODS OF SOLVING THERMOPLASTICITY PROBLEMS TAKING ACCOUNT OF THE LOADING HISTORY

Iu. N. Shevchenko [1968] 14 p refs Transl. into ENGLISH from a RUSSIAN report
CFSTI: HC $3.00/MF $0.65

The relationships for determining the dependence between the stresses and strains in the theory of small elastoplastic deformations are formulated, and two approximate methods of solving plasticity problems are discussed. In the method of variable elastic parameters, the stress--strain relationships are written in the form of Hooke's law. The solution is determined by successive approximations, in each of which the ordinary problem of elasticity theory with variable elastic parameters, determined from the preceding approximation, is solved. In the method of elastic solutions for solving thermoplasticity problems, the dependence between the stress and strain components for both active loading and for unloading are formulated. The whole deformation process is divided into a series of steps in such a way that the times demarking the loading (unloading) stages would possibly coincide with times of change in the deformation process of the individual body elements from loading to unloading, and vice versa. The differential equation is then solved for the selected times for given boundary conditions by successive approximations. M.G.J.

N68-29648
VIBRATIONS OF A CIRCULAR PLATE DUE TO THERMAL IMPACT

A. D. Kovalenko and V. G. Karnaukhov 1968 4 p refs Transl. into English from Akad. Nauk Ukr. Rsr, Ser. A, Fiz.-Tekh. I Mat. Nauk (Kiev), no. 2, 1968 p 152-157
CFSTI: HC $3.00/MF $0.65

Consideration is given to the problem of determining the vibrations of a freely supported circular plate under the effect of a suddenly applied thermal flux to the surface. The lower surface of the plate and its outline are considered ideally heat insulating. The equation of plate motion is formulated and the solution is found for both the quasi-static and dynamic part. Author

N68-29649
ON A METHOD OF SOLVING DOUBLY-PERIODIC BIHARMONIC PROBLEMS OF THE THEORY OF ELASTICITY

A. N. Guz' [1968] 4 p refs Transl. into ENGLISH from Dopovidi Akad. Nauk Uk. RSR (Kiev), no. 12, 1967 p 1098-1101
CFSTI: HC $3.00/MF $0.65

A simplified method based on the application of some series of real variables is proposed for solving doubly-periodic biharmonic problems of elasticity theory. Equations are derived for an infinite plate, weakened by a doubly-periodic lattice of identical circular holes of radius r_0, with identical boundary conditions on each. Each hole is connected with its own coordinate system, and all coordinates are nondimensional, referred to r_0. The solution is sought in the form which satisfies the double periodicity conditions. Author

N68-29662
FUNDAMENTAL EQUATIONS OF FLEXIBLE PLATES FOR A COSSERAT MEDIUM

G. A. Gevorkian [1968] 10 p refs Transl. into ENGLISH from Prikl. Mekh. (USSR), v. 3, no. 11, 1967 p 59-67
CFSTI: HC $3.00/MF $0.65

The fundamental equilibrium equations, continuity relationships and boundary conditions are derived for flexible plates whose material is a Cosserat medium. The Kirchhoff-Love hypothesis is assumed in the investigations. As an illustration, the problem of large deflections of an edge-fixed rectangular plate with finite ratio of the sides is considered. The problem is solved by the Bubnov-Galerkin method and the deflection at the center of the plate is found. Author

N68-29663
ON ELASTIC WAVE PROPAGATION IN VARIABLE THICKNESS SHELLS OF REVOLUTION UNDER AXISYMMETRIC STRAIN

N. D. Veksler [1968] 5 p refs Transl. into ENGLISH from Prikl. Mekh. (USSR), v. 4, no. 4, 1968 p 35-38
CFSTI: HC $3.00/MF $0.65

Discontinuities on wave fronts are investigated within the scope of the simplest version of a Timoshenko type linear theory. An asymptotic method of inverting contour integrals is used. The investigation is conducted for three cases of kinematic boundary conditions for which the velocity of one of the three desired functions is given, and the other two functions are assumed zero. Author

N68-29664
ON DYNAMIC STRESS CONCENTRATION IN A PLATE WITH TWO CIRCULAR HOLES

V. T. Golovchan [1968] 6 p refs Transl. into ENGLISH from Prikl. Mekh. (USSR), v. 3, no. 11, 1967 p 23-28
CFSTI: HC $3.00/MF $0.65

A solution is presented for the problem of stress concentration in an infinite plate with two identical circular holes, to whose contours harmonic pressure is applied. The approximate solution of the infinite system of algebraic equations of the considered problem, the stresses on the line of centers of the holes, and the errors in compliance with the boundary conditions were computed on an electronic computer. Author

N68-29673
THERMOELASTIC STRESSES IN RIBBED CYLINDRICAL SHELLS

V. A. Zarutskii and T. A. Neshumaeva [1968] 7 p refs Transl. into ENGLISH from the book "Thermal Stresses in Structural Elements" Kiev, Naukova Dumka, no. 7, 1967 p 202-208
CFSTI: HC $3.00/MF $0.65

Equilibrium equations in displacements and boundary conditions are formulated for a circular closed cylindrical shell reinforced by a regular system of discretely disposed stringers. It is assumed that the temperature of the casing is constant over the thickness, and the stringer temperature over the height. The casing temperature varies arbitrarily in the axial direction and cylindrically symmetrical in the circumferential direction. The temperature of the stringers varies arbitrarily along their length. The stress state of the shell is cyclically symmetric. Numerical examples of the influence of the bending stiffness of the stringers on the stress-strain state of a hinge-supported shell are studied. K.W.

N68-29680 Delaware Univ., Newark.
FREE EXTENSIONAL OSCILLATIONS OF A THIN ELASTIC BEAM EXPERIENCING EXTREMELY LARGE DEFLECTIONS

Scott Rosin Woodall (Ph.D. Thesis) 1968 225 p
Available from Univ. Microfilms: HC $10.15/MF $3.00 Order No. 67-11747

This thesis is concerned with the analysis of planar motions of a thin elastic beam experiencing free vibrations involving finite displacements but small strains. A fixed inertial reference frame and a Lagrangian description of the motion are employed in the

derivation of the governing equations of motion. By taking advantage of the fact that the strains are small (and by neglecting rotatory inertia) these governing equations are simplified to a more manageable but still meaningful form. This simplified system of equations is shown to be of parabolic type. Solutions of this simplified set of equations are explicitly obtained for the case of the simply-supported beam and the free beam. For the former case a finite difference solution (which reflects the parabolic nature of the continuous system), a Galerkin approximate solution and a (regular) perturbation solution are found. The results are discussed and compared. For the free beam only a Galerkin approximate solution is obtained. Dissert. Abstr.

N68-29699 Royal Netherlands Aircraft Factories Fokker, Amsterdam.
FATIGUE TESTING OF THE F-28 "FELLOWSHIP"
Edward J. van Beek [1967] 29 p refs Presented at the 5th I.C.A.F. Symp. on Aircraft Fatigue—Design, Operational and Economic Aspects, Melbourne, 22-24 May 1967

A fatigue test plan is presented for the Fokker F28 high performance twin turbofan aircraft designed specifically for short haul commercial operation. The scheduled tests are intended to demonstrate the flight structure integrity, clear the aircraft for a crack-free and trouble-free life of 60,000 flights, and prove for certification the required safe life and fail-safe characteristics. Fatigue testing is scheduled for front fuselage, main fuselage behind cockpit to rear pressure bulkhead, rear fuselage and T-tail, complete wing, flap with supporting and drive structure, and undercarriage with back-up structure. Fatigue loads for these tests will be based on a standardized equivalent flight of the aircraft incremented into 22 intervals from takeoff to landing. The flight and ground loads considered are: gust, ground–air–ground cycle, landing and ground handling, cabin pressurization, aircraft loading and unloading, elevator maneuver loads, control surface deflection, and flap operation. Test set-up and loading program for each airframe element are discussed. D.H.B.

N68-29710# Boeing Scientific Research Labs., Seattle, Wash. Solid State Physics Lab.
CRACK EXTENSION BY ALTERNATING SHEAR
F. A. Mc Clintock (MIT) and R. M. N. Pelloux Feb. 1968 32 p refs
(DI-82-0708; AD-669531)

A comparison of the slip line flow field at the tip of a sharp crack and of a blunted crack shows that a sharp crack can be extended by alternating shear until it becomes blunted. Crack tip blunting is associated with high strain concentration and fracture by hole growth and coalescence. Crack extension by alternating shear has been obtained in fully plastic, plane strain sharply notched, singly and doubly grooved tensile specimens. Electron fractography shows crack extension by alternating shear at the tip of cleavage and fatigue cracks. It is shown that fatigue crack propagation is the result of repeated cyclic crack extension by alternating shear. Author (TAB)

N68-29713# ARA, Inc., West Covina, Calif.
RESEARCH ON ENERGY ABSORBING STRUCTURES, PART 6 Annual Report, 1 Feb. 1967–31 Jan. 1968
Bernard Mazelsky Mar. 1968 72 p refs
(Contract AF49(638)-1521)
(ARA-94, Pt. 6; AFOSR-68-0489; AD-669836)

An analytical method for predicting very large deflections of flat rectangular plates subjected to non-symmetric loads, with respect to the centerline of the flat plate, has been developed and correlated with experiment. For deflections below twenty percent of the plates length and/or width, the theory of Mansfield and Kleemans could be used. For large deflections and loading conditions, their theory is inapplicable due to the change in moment arm caused by the plates deflection. The present theory properly accounts for the moment arm correction for plate deflections up to sixty percent of its length and/or width. An extensive experimental study was made on low cycle fatigue of thin walled specimens. The total energy absorbed in cyclic torsion for two types of aluminum A-1100 and 2024 T-3 were measured. The 2024 aluminum has 4 to 5 times the energy absorption capability of the A-1100 aluminum. Axial compressive stress on cyclic torsion of beryllium copper increased the total energy absorption 3 to 4 times as that when no compressive axial stress was applied. The large deflection theory was applied to the successful design and manufacture of an energy absorbing highway protective barrier system for the Department of Transportation. Author (TAB)

N68-29727
ON THE SOLVABILITY OF THE NONLINEAR REISSNER EQUATIONS FOR NON-SHALLOW SYMMETRICALLY LOADED SHELLS OF REVOLUTION
L. S. Srubshchik [1968] 6 p refs Transl. into ENGLISH from Prikl. Mat. i Mekh. (Moscow), v. 32, no. 2, 1968 p 328–332

An existence theorem is proven for solving the Reissner equations for various boundary conditions and under certain constraints imposed on the class of shells under consideration. It is assumed that for $0 < a \leq \xi \leq b < \infty$, i.e., within the range of variation of the parameter ξ, the following conditions hold: $0 < L_1 \leq r/a \leq L_2 < \infty$, $a^2(\xi) = (dr/d\xi)^2 + (dz/d\xi)^2$. The problem is methodologically interesting in that nonlinear boundary conditions occur in addition to the nonlinear equilibrium differential equations and the compatibility of the shell strains. K.W.

N68-29732 Virginia Univ., Charlottesville.
THE FLOATING ELASTIC SPHERICAL SHELL WITH A CIRCULAR HOLE
Domingos Boechat Alves (Ph. D. Thesis) 1966 185 p
Available from Univ. Microfilms: HC $8.40/MF $3.00 Order No. 67-3774

The state of displacement throughout a floating thin spherical shell with a large circular hole constrained by a stiffening ring device was determined. Differential equilibrium equations and boundary conditions in terms of displacements are derived based on the standard shell assumptions. These equations are transformed to finite difference "molecular" equations in spherical coordinates and the resultant system of simultaneous equations is solved by matrix inversion. To investigate the reliability of the membrane theory, the above system is reduced to the membrane difference equations by setting h^2/R^2 equal to zero. Numerical results obtained from the variation of shell and ring parameters are studied. These parameters include ring characteristics, Poisson's ratio, shell parameters and the kind of support. The solutions were obtained using a Burroughs B-5500 digital computer. Dissert. Abstr.

N68-29805 Cornell Univ., Ithaca, N. Y.
MAGNETOELASTIC STABILITY VIBRATION
Francis Charles Moon (Ph.D. Thesis) 1967 191 p
Available from Univ. Microfilms: HC $8.80/MF $3.00 Order No. 67-11346

The static and dynamic stability of a linear isotropic elastic beam-plate in a magnetic field using the Amperian current model for the magnetic forces is examined. For an infinite elastic plate in a static magnetic field, normal to the plate surface, critical values of the field are found for which the plate may assume a non trivial displacement pattern of arbitrary amplitude. The field equations of the plane strain theory of elasticity and magnetostatics are solved simultaneously and are coupled through the boundary conditions. The theory is extended using classical beam and plate theories to finite width and length plates. The phenomenon of magnetoelastic buckling of a thin rectangular ferromagnetic cantilever in a transverse magnetic field has been estab-

lished here experimentally. The results indicate that the critical field, B_c is independent of the magnetic permeability for these materials. Dissert. Abstr.

N68-29846
ON THE INFLUENCE OF BOUNDARY CONDITIONS ON THE VIBRATION FREQUENCY AND CRITICAL STRESS OF A CYLINDRICAL SHELL
L. I. Manevich and A. V. Stezhko [1968] 7 p refs Transl. into ENGLISH from Prikl. Mekh. (USSR), v. 4, no. 3, 1968 p 11–18
CFSTI: HC $3.00/MF $0.65

Free vibrations and stability were studied for an orthotropic cylindrical shell loaded by axial compressive forces. Influence of elastic endface stringers on critical stress, frequency and a mode of shell vibration, and logical stiffness characteristics of the stringers were determined. The analysis applied to the axisymmetric deformation of the shell neglected the longitudinal inertial forces. Geometric stiffness parameters and the roots of the characteristic equations were considered. Shells with and without reinforcement endface ribs were considered, and details of the necessary equations are included for each case. Computations were made for the fundamental vibration both for the symmetric and skew-symmetric modes. On the basis of graphs, it was shown that the stiffness parameters of the ribs could be selected so that the frequencies would differ somewhat from the vibrational frequencies of a hinge-supported shell. M.W.R.

N68-29876 Maryland Univ., College Park.
THE INTERPRETATION OF IMPACT TESTS
Carl Hugo Walther (Ph. D. Thesis) 1967 134 p
Available from Univ. Microfilms: HC $6.40/MF $3.00 Order No. 67-11329

A theoretical and experimental investigation of the production and propagation of compressive stress in short specimens of annealed aluminum and annealed carbon steel by means of longitudinal collision of cylindrical bars was performed. The strains produced in aluminum specimens were found to be approximately proportional to the length of the impacting bars, and hence to the duration of the impact, when the striking velocity was maintained constant. In contrast, steel specimens exhibited the pronounced delay in the onset of plastic yielding which has been reported by other experimenters, that delay being less for the higher striking velocities. The stress at which yielding first occurred was approximately twice the static yield point of the material. These phenomena are not explained by a modified shock wave propagation theory which was developed to interpret the results of tests. It is suggested that the strain produced in impact tests of steels showing the time delay phenomenon may be affected by the length of striking bars used. Dissert. Abstr.

N68-29895# Aeronautical Research Council (Gt. Brit.).
OPTIMUM FIBRE ARRANGEMENTS FOR REINFORCED SHEETS UNDER COMBINED LOADING
G. Z. Harris 1968 74 p refs Supersedes RAE-TR-66361; ARC-29320
(ARC-CP-975; RAE-TR-66361; ARC-29320; AD-833486)

Sheets having three directions of fibre reinforcement are considered on the basis of netting analysis. Load envelopes of shear combined with both uniaxial and biaxial tension are assumed and optimum fibre arrangements are determined on the assumption that limits exist on the compressive and tensile forces which may be developed in a fibre. Such optimum fibre arrangements are compared with the best-arranged isotropic reinforced sheets and with hypothetical solid sheets having the same properties as the fibres. The total allowable load envelopes of the optimum arrangements are derived and are related to the prescribed load envelopes. The elastic constants of the optimum systems are also derived. Author (TAB)

N68-29898 Illinois Univ., Chicago.
CRATER SIZE IN HYPERVELOCITY IMPACT
Ilan Silberstein (Ph. D. Thesis) 1967 86 p
Available from Univ. Microfilms: HC $4.60/MF $3.00 Order No. 67-11920

The solution developed in this work is carried out in two stages: In the first stage the assumptions are made that the process of cratering is a propagation of a hemispherical shock wave which is initiated instantaneously from the point of impact and expands into the target material. The cratering is assumed to cease when the pressure at the shock front has decayed to a value lower than the theoretical shear strength of the target material. An additional assumption is made that the process of propagation is isentropic and adiabatic. An estimated value for the radius of the crater is obtained. The second stage of the solution consists of removing the last assumption and prescribing two dissipative modes The first mode accounts for losses in the availability of the energy. The second mode accounts for the energy loss through the vaporization of the material ejected from the crater. A corrected value is obtained for the size of the crater. The results indicate that the importance of the energy losses in vaporizing the material ejected from the craters overshadows all other factors involved in the decay of the shock. Dissert. Abstr.

N68-29913 Boeing Co., Renton, Wash.
FATIGUE DESIGN AND TEST PROGRAM FOR THE AMERICAN SST
D. R. Donaldson and K. J. Kenworthy [1967] 26 p refs Presented at the 5th Intern. Comm. on Aeron. Fatigue Symp. "Aircraft Fatigue—Design, Operational and Econ. Aspects", Melbourne, 22–24 May 1967

The American supersonic transport will be a large, variable-sweep-wing airplane constructed primarily of titanium alloys. It will cruise at Mach 2.7 and have a service life in excess of 50,000 flight hours. In addition to the perplexing safety and economic aspects of structural fatigue for today's airplanes, the advanced technology of the SST produces an operational environment and unique airplane configuration features that must be considered. The temperature magnitudes and variations associated with a supersonic flight affect the structural properties and produce thermal stresses. Long service life data for titanium airframe structure is lacking; however, the use of titanium results in higher cruise speeds and proportionately lower thermal stresses than are obtainable with aluminum alloys. Author

N68-29928 Polytechnic Inst. of Brooklyn, N. Y.
APPLICATION OF VARIATIONAL METHODS TO THE LINEAR AND NON-LINEAR ANALYSIS OF DYNAMIC BUCKLING OF COLUMNS AND PLATES
Horst Hans Orbanowski (Ph.D. Thesis) 1967 140 p
Available from Univ. Microfilms: HC $6.60/MF $3.00 Order No. 67-10958

Applying the variational equation of motion and making free use of Galerkin's variational method, the effect of rotary inertia and transverse shear deformation on the regions of dynamic instability in the linear case, and on the response curves of lateral vibration in the non-linear case is investigated. Non-linearities considered are approximate non-linear elasticity, as presented by V. V. Novozhilov, and non-linear inertia. Excitation is provided by axial time dependent end forces. The equations for the stable and unstable branches of the response curves with non-linear elasticity are derived for a rod with hinged ends. The non-linear equations are then reduced to the linear case, and the effect of rotary inertia and shear on the upper and lower boundaries of the linear regions of instability is studied in the principal and second regions. For the same rod with non-linear inertia, the equations for the response curves with and without rotary inertia and shear are developed. The response curves in the principal and second regions of dynamic instability with non-linear elasticity, with and without rotary inertia

and shear, are derived for a simply supported homogeneous plate with excitation of the same frequencies at two perpendicular edges. Equations for the response curves of lateral vibrations for a homogeneous plate with excitation of different frequencies at two perpendicular edges are developed for the principal region of dynamic instability with non-linear elasticity. Dissert. Abstr.

N68-29958*# National Aeronautics and Space Administration, Washington, D. C.
PROPELLER BALANCING DURING OPERATION [DOVAZOZANI VRTULI ZA PROVOZU]
Jiri Statecny Jan. 1968 12 p refs Transl. into ENGLISH from Zpravod. Vyzkumny A Zkusebni Letecky Ustav (Czech.), v. 6, 1966 p 33–38
(NASA-TT-F-11411) CFSTI: HC$3.00/MF$0.65 CSCL 20K

An unbalanced propeller is one of the factors causing vibration of the aircraft. The increased requirements for the comfort of the crew and the passengers therefore have a bearing on the attempts to attain an accurate balancing of the propeller. An airframe sensitive to vibrations poses very high precision balancing requirements. The most accurate balancing during production does not guarantee a satisfactory balancing after the propeller is mounted on the shaft. The only possible solution is, therefore, an additional final balancing on the aircraft. This article presents a working theory and description of the instruments used for additional balancing of the propeller during operation on a single plane. Vibrations produced by any type of unbalanced propeller are, in this case, eliminated by an equivalent of the mass–force causing the unbalancing. In principle, the instruments may also be used when balancing any and all rotating masses in two planes while in operation. Author

N68-29972*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
PLANE STRAIN FRACTURE TOUGHNESS TESTS ON TWO-INCH-THICK MARAGING STEEL PLATE AT VARIOUS STRENGTH LEVELS
J. E. Srawley Washington 1968 25 p refs To be presented at the 2d Intern. Conf. on Fracture, Brighton, 13-18 Apr. 1969
(NASA-TM-X-52470) CFSTI: HC$3.00/MF$0.65 CSCL 20K

Results of tests of 1.8 inch-thick threepoint bend and compact specimens substantiate the current proposed ASTM recommended practice for plane strain fracture toughness (K_{Ic}) testing. Erroneously low results were obtained with 0.5-inch thick bend specimens when the ratio of K_{Ic} to yield strength exceeded 0.45 inch$^{1/2}$, thus emphasizing the importance of requiring minimum specimen dimensions proportional to the square of this ratio. Shallow face grooves in 0.5-inch-thick specimens had no useful effect. The K_{Ic} values were approximately proportional to the reciprocal of the square of yield strength, and also to a strain hardening index derived from the ratio of yield to ultimate tensile strength. Author

N68-29975 Kansas Univ., Lawrence.
STABILITY OF FLEXIBLE NOZZLE STRUCTURES
Vavanatha Sundararajan (Ph.D. Thesis) 1966 105 p
Available from Univ. Microfilms: HC $5.20/MF $3.00 Order No. 67-10837

In the course of the present investigation the equilibrium shapes and stability of a two dimensional flexible membrane supported at its ends and placed above an inclined rigid wall with an inviscid, incompressible fluid flowing between the wall and the membrane were determined. The self-excited motion of an infinitely long flexible membrane was also analysed. The static equilibrium shapes of a membrane with constant tension and variable length was determined using Bernoulli expression for static pressure distribution. The stability of the equilibrium positions depended on the elastic characteristics of the membrane. The stability of the various equilibrium shapes was analysed from the point of view of potential energy. The condition of stability was obtained by disturbing the membrane from its equilibrium position and calculating the work done by the aerodynamic pressure on the membrane. Dissert. Abstr.

N68-30045*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
A NUMERICAL PROCEDURE FOR CALCULATING STRESS AND DEFORMATION NEAR A SLIT IN A THREE-DIMENSIONAL ELASTIC-PLASTIC SOLID
David J. Ayres Washington NASA Aug. 1968 31 p refs
(NASA-TN-D-4717) CFSTI: HC$3.00/MF$0.65 CSCL 20K

A finite difference procedure for the computation of the stress in a three dimensional solid is presented. This iterative technique, based on Newton's method for determining the roots of a system of polynomials, is applicable to both linear and nonlinear problems. The sample problems that are treated are the analysis of a plate in plane strain with a slit at its center, the analysis of a thick plate with a rectangular slit through its thickness, and the analysis of a thick plate containing a semielliptical slit which extends only halfway through its thickness. The loading condition in all sample problems is uniaxial tension normal to the slit. Author

N68-30051
ON THE RELATIONSHIP BETWEEN VIBRATIONAL AND ACOUSTIC EFFECTS ON AN ELASTIC PLATE
V.A. Pupyrev [1968] 8 p refs Transl. into ENGLISH from Inzh. Zh. Mekh. Tverdogo Tela (USSR), no. 1, 1968 p 82–86
CFSTI: HC$3.00/MF$0.65

Forced vibrations of a structure for a vibration stand are examined. The role of elastic coupling and of the acoustic medium in the transmission of vibrations from the stand to a plate during wideband excitations is clarified. Author

N68-30092#
BRIEF SURVEY OF RESEARCH ON THE MECHANICS OF DEFORMABLE SOLIDS IN THE ACADEMY OF SCIENCES OF THE UKRAINE SSR
G. N. Savin [1968] 14 p refs Transl. into ENGLISH from Ukr. Mat. Zh. (Kiev), v. 20, no. 2, Mar.–Apr. 1968 p 183–191
CFSTI: HC$3.00/MF$0.65

The dynamics of a variable length inelastic filament as applied to mine hoists from great depths is reviewed, and the mathematical formulation of such problems is detailed in an overview of research activities on deformable solids. Developments related to the mathematical theory of elasticity are also reviewed; and attention is given to stress concentration around holes in plates and thin slabs as well as to pressure distributions in the contact zone of deformable bodies. Mention is made of problems related to an inhomogeneous and multilayered half space and to the combined torsion of an elastic finite circular cylinder with a half space having different characteristics. M.W.R.

N68-30097
PROBLEM OF CONNECTING A PLATE TO A CYLINDRICAL SHELL
A. P. Tarasenko [1968] 8 p refs Transl. into ENGLISH from Prek. Mekh. (USSR), v. 4, no. 2, 1968 p 55–62
CFSTI: HC$3.00/MF$0.65

The general problem of nonsymmetric reinforcement of a circular hole in a plate by a thin cylindrical shell is considered, and solutions are evolved for the cases of reinforcement by a thin rib and an infinite cylindrical shell. Both symmetric and unilateral reinforcement in a biaxially strained plate were treated as cases of nonsymmetric strengthening, and the domains of applicability were considered for three versions of formulating the overall reinforcement problem. M.W.R.

N68-30103# Purdue Univ., Lafayette, Ind. School of Aeronautics, Astronautics, and Engineering Sciences.
THE CONSTANT STRETCH RATE HISTORY, COMPARISON OF THEORY WITH EXPERIMENT
Charles W. McGuirt and George Lianis Feb. 1967 56 p refs
(Grant NSF GK-413)
(AA+ES-67-2)

To determine whether a simplified constitutive equation can accurately approximate the behavior of certain viscoelastic materials under time dependent histories, a series of isothermal uniaxial stress relaxation tests were conducted on commercial materials at various extension ratios. This was followed by a two-step isothermal uniaxial stress relation test. The constitutive equation, containing only four relaxation functions and three steady-state coefficients, is formulated and applied to these results to evaluate the relaxation functions for each material. A series of constant stretch-rate loading and unloading tests were conducted on the materials to compare with the approximation based on the material functions evaluated from step relaxation data. Agreement between the stress values based on the simplified constitutive equation and the measured values, for sufficiently slow motions appears very satisfactory. D.H.B.

N68-30111# Naval Research Lab., Washington, D. C.
ARPA COUPLING PROGRAM ON STRESS-CORROSION CRACKING Quarterly Report, 1 Jan.–30 Apr. 1967
Feb. 1968 34 p refs
(NRL-MEMO-1864; QR-5; AD-669487)

A progress report of the research investigations being carried out on the problem of stress-corrosion cracking of high strength materials is presented. Work concerning physical metallurgy, surface chemistry, fracture mechanics, and characterization tests and translation related to stress-corrosion cracking is described. The materials being studied include high strength steels, titanium alloys, and aluminum alloys. Abstracts of recently published reports and a diary of events are included. Author (TAB)

N68-30114# Naval Research Lab., Washington, D. C.
ADVANCES IN FRACTURE TOUGHNESS CHARACTERIZATION PROCEDURES AND IN QUANTITATIVE INTERPRETATIONS TO FRACTURE-SAFE DESIGN FOR STRUCTURAL STEELS
W. S. Pellini 3 Apr. 1968 88 p refs
(NRL-6713; AD-669690)

The state of knowledge of fracture-safe design for steels is examined in relation to the requirements for achieving practical solutions to general engineering problems. Analytical procedures evolved from fracture mechanics theory are demonstrated to provide for quantitative interpretations of engineering fracture toughness tests. It is thus possible to couple the procedural simplicity which is inherent to engineering tests with the analytical advantages of fracture mechanics theory. The coupling of these two approaches provides for practical advances in fracture-safe design which cover the totality of general engineering problems and requirements. The Charpy V test is shown to have applicability for use in the described fashion primarily in relation to the strength transition for high strength steels. The combined diagrams should serve the needs of both the materials and design fields. Author (TAB)

N68-30159
NATURAL VIBRATIONS OF ORTHOTROPIC CYLINDRICAL SHELLS
V. S. Gontkevich [1968] 4 p refs Transl. into ENGLISH from Izv. Akad. Nauk Kaz. (Kazan), v. 1, 1961, p 124-129
CFSTI: HC $3.00/MF $0.65

The natural vibrations of isotropic cylindrical shells with different boundary conditions were investigated by the Rayleigh-Ritz method, where the components of the displacements were expressed by beam functions. The expressions for the energy and strain components of the shells are given along with expressions for satisfying the boundary conditions for various displacements. This method may also be used for investigating the natural vibrations of orthotropic cylindrical shells. B.S.D.

N68-30164# Fabric Research Labs., Inc., Dedham, Mass.
INVESTIGATION OF THE HIGH-SPEED IMPACT BEHAVIOR OF FIBROUS MATERIALS, FEBRUARY 1966–DECEMBER 1967
Robert J. Coskren Wright-Patterson AFB, Ohio AF Mater. Lab. Feb. 1968 130 p ref Submitted for publication
(Contract AF 33(615)-3569)
(AFML-TR-68-46; AD-670180)

Four newly developed fibers (PBI,X-101, PRD-14 and Beta glass) were evaluated in webbing form (3000-9000 lbs breaking strength) for rupture energy absorption capacity at 200,500, and 700 ft/sec (strain rates of 8,000; 20,000 and 28,000%/sec based upon an initial 2.5 foot gage length). The dynamic energy absorption capability of the PRD-14 webbing is essentially unchanged over the entire speed range studied. The rupture energy of the X-101 webbing is diminished by 20% as testing speed is increased up to 500 ft/sec and then exhibits a loss of approximately 70% at 700 ft/sec. The PBI exhibits a 50% loss from quasi-static up to the 500 ft/sec testing speed and diminishes to approximately 10% of quasi-static at 700 ft/sec. The energy level of the Beta glass improves or remains almost unchanged in the entire speed range. Generally, however, this level is of such a low order that the usefulness of Beta glass is limited to cases where exposure to elevated temperatures in excess of 850F may be anticipated. Six fibers were evaluated in tape form (300-675 lbs breaking strength) for energy absorption capacity at speeds of 50, 100 and 150 ft/sec (strain rates of 1,111; 2,222 and 3,333%/sec) at various temperatures. To obtain a basis for comparison, quasi-static (Instron) tests were also performed at corresponding temperatures. Results indicate that, within the precision of the equipment at 70F, most materials are only slightly sensitive to strain rate over the high-speed range studied. Author (TAB)

N68-30224
DYNAMIC THERMOELASTICITY PROBLEMS FOR PLATES AND SHELLS IN THE PRESENCE OF RADIATION
V. V. Bolotin [1968] 5 p refs Transl. into ENGLISH from the book "Trudy, Theory of Plates and Shells Conf., vol. 1" Kazan, Izd. AN Kaz. SSR, 1961 p 27–32
CFSTI: HC $3.00/MF $0.65

Deformations of plates and shells subjected to sudden heating by radiation are analyzed using a sequential analysis approach to the heat conduction and thermoelasticity equations. It is assumed that since essentially the Kirchhoff-Love hypothesis on conservation of a normal element is used in forming the thermoelasticity equation in plate and shell theory, an analogous hypothesis in the heat conduction equation should be also introduced. The proposed hypothesis for the heat conduction equation is developed using the Ostrogradskii-Euler variational equations and the Hankel transform. To illustrate the applicability of the proposed approach an infinite plate of constant thickness which is at rest, is subjected to radiation, and whose intensity drops with time; is analyzed. S.C.W.

N68-30237#
ON A MOST SIMPLE VERSION OF THE EQUATIONS OF GEOMETRICALLY NONLINEAR THIN SHELL THEORY
L. A. Shapovalov [1968] 8 p refs Transl. into ENGLISH from Inzh. Zh., Mekh. Tverdogo Tela (USSR), no. 1, 1968 p 56–62
CFSTI: HC $3.00/MF $0.65

Nonlinear equations of thin shell theory constructed on the basis of the Kirchhoff-Love hypothesis in a quadratic approximation

are considered. In conformity with the geometrically nonlinear theory of elasticity it is assumed that the elongations and shears are small compared with the angles of rotation of the shell element. Formulas for the shell displacement in the direction of the normal to the middle surface, are refined. On the basis of the refinements made, a derivation is given of the nonlinear dependences for the elongation, shear, curvatures and torsion. Fundamental equations of the nonlinear theory of elasticity of shells, which correspond to the found expressions for the strains, curvatures, and torsion, are obtained by variational methods. Author

N68-30245
ANALYSIS OF A SHELL WITH A VARIABLE SECTION RIB UNDER RADIAL LOADING
E. V. Binkevich, A. L. Gashko, and V. P. Manza 1968 10 p refs Transl. into English from Samoletostroenie i Tekhn. Vozdushn. Flota (USSR), no. 9, 1967 p 75–85
CFSTI: HC$3.00/MF$0.65

An energy method used to analyze shells with variable section ribs is extended to the analysis of a shell with a variable section rib under conditions of radial loading. Formulas are deduced which permit the solution to be obtained numerically, and an example is given to illustrate the feasibility of the proposed approach. S.C.W.

N68-30269# Kentucky Univ., Lexington. Dept. of Engineering Mechanics.
DYNAMIC STRAIN CONCENTRATION FACTOR FOR A NOTCH
Dennis R. Weaver 1968 65 p refs
(Contract AF 49(638)-1646)
(AFOSR-68-0827; AD-670172)

Annealed aluminum rods containing a circumferential notch were subjected to several impact loads. For each impact, the strain histories of the respective strain gauges were recorded on an oscilloscope. From the strain history data concentration factors were computed for the material response in both the elastic and plastic region. The concentration factors, as functions of time, were averaged for each level of impact and then compared with the static elastic concentration factor. Two general conclusions are made from the averaged time history curves for each impact level. First, the dynamic concentration factor is equal to the static concentration factor in the elastic range of the material response. Secondly, for the plastic range of material response in the notch, the average dynamic concentration factor is greater than the static elastic value. The ratio of the plastic response to the elastic value depends on the magnitude of the impact loading and the amount of previous plastic deformation that the notch had undergone. Author (TAB)

N68-30286# Southampton Univ. (England). Inst. of Sound and Vibration Research.
THE USE OF MODELS IN THE SIMULATION OF THE EFFECTS OF SONIC BOOMS ON STRUCTURES
N. Popplewell Feb. 1968 22 p refs Presented at the Symp. on Aeron. Acoustics, Toulouse, 6–8 Mar. 1968
CFSTI: HC$3.00/MF$0.65

From the dimensional analysis of the response of a simply supported plate to an N-wave at normal incidence backed by an acoustic pressure the important parameters and scaling laws are developed for an N-wave moving over a rectangular structure. Model measurements of mid-point wall accelerations and internal acoustic pressure time histories were ascertained for different angles of incidence, wavelengths and peak pressures of the simulated N-wave. Subsequently, the effect of introducing a variable sized, rectangular opening in one of the faces was investigated. The experimental results for wall accelerations are compared with theoretical results derived from a finite element analysis of the structure. Author

N68-30292# Indian Inst. of Sciences, Bangalore. Dept. of Aeronautical Engineering.
NATURAL FREQUENCIES OF VIBRATION OF ISOTROPIC FLAT PLATES – 2
S. Durvasula, R. N. Burbure, and S. Srinivasan Jul. 1968 41 p refs
(AE-216S) CFSTI: $3.00

Data on the natural frequencies of uniform, thin, elastic, isotropic, flat plates, scattered widely in the published literature, have been systematically compiled, reduced to a uniform standard nondimensional parameter and presented in the form of tables for convenient reference in design. Natural frequencies of trapezoidal, triangular, circular and elliptical plates with different combinations of edge conditions like free, simply supported, clamped and elastically restrained are given. A table pertaining to a few plates with miscellaneous edge conditions has also been added at the end. Author

N68-30298# British Aircraft Corp., Luton (England).
FATIGUE TEST RESULTS AND ANALYSIS OF 11 PISTON PROVOST WINGS TO DETERMINE THE EFFECT OF ORDER OF PROGRAMMED LOAD
H. E. Parish Jan. 1968 7 p refs
(Contract KC/G/027/CB.5(a))
(S&T-Memo-5/67) CFSTI: HC$3.00/MF$0.65

Fatigue results of 11 wings programme-loaded in ascending order were compared with 41 wings tested in descending order. Results indicate a substantial reduction in the log mean life when testing in ascending order but negligible difference in variance. Comparison of these results with results from two other studies indicates that the magnitude of peak stress and shape of the spectrum applied, very much influences whether descending or ascending order of load gives the longer endurance. Author

N68-30299# British Aircraft Corp., Luton (England).
FATIGUE TEST RESULTS AND ANALYSIS OF FOUR PISTON PROVOST WINGS TESTED IN AN ASCENDING-DESCENDING ORDER OF LOADING
H. E. Parish Mar. 1968 11 p refs
(Contract KC/G/059/CB5(B))
(S&T-Memo-1/68) CFSTI: HC$3.00/MF$0.65

Results of fatigue tests on four wings program loaded in lo-hi-lo order are compared with similar tests performed in hi-lo and lo-hi orders reported previously. The results lie almost mid-way between the results for hi-lo and lo-hi tests. No significant difference is shown in either the variance or mean value since the results lie within the scatter of the previous tests. Author

N68-30312
SEMI-BINDING THEORY OF EQUILIBRIUM OF THICK SLABS
Iu. A. Gruzdev and V. K. Prokopov [1968] 11 p refs Transl. into ENGLISH from Prikl. Mat. i Mekh. (Moscow), v. 32, no. 2, 1968 p 344-352
CFSTI: HC$3.00/MF$0.65

Attention is given to overcoming the difficulties encountered in obtaining force boundary conditions in problems of tension and bending of thick slabs. Integration of the variation in the strain potential energy of the slab over its thickness and introduction of semi-bending stress state characteristics substantially simplified the analysis and permitted the geometric and static boundary conditions to be obtained in general form. Detailed formulations for the equations for determining tension in a slab and its bending are presented. M.W.R.

N68-30314
ON EQUILIBRIUM MODES OF A RUBBER SPHERICAL SHELL UNDER INTERNAL PRESSURE

Y. I. Feodos'ev [1968] 9 p refs Transl. into ENGLISH from Prikl. Mat. i Mekh. (Moscow), v. 32, no. 2, 1968 p 339–344
CFSTI: HC $3.00/MF $0.65

Mathematical models were evolved and examples are presented to indicate the equilibrium modes of a rubber spherical shell under internal pressure. Conditions for the origin of equilibrium modes were considered that are different but similar to the spherical case; and it was assumed that the shell receives a large uniform elongation in the subcritical state, from which deviations were small. A four-time approximation preceded the formulation of the equilibrium equations, and it was shown that at some pressures there existed a spherical mode in addition to the fundamental spherical mode for the rubber shell. Stability of the equilibrium modes were investigated, and some computational results are included.
M.W.R.

N68-30323# Houston Univ., Tex. Dept. of Mechanical Engineering.
FREE VIBRATIONS OF RING-AND-STRINGER-STIFFENED CONICAL SHELLS
Otto E. Cranwelge, Jr. and D. Muster Apr. 1968 116 p refs
(Contract Nonr-4492(01))
(TR-9; AD-669499)

Strain-displacement relations are developed for a thin truncated circular conical shell and its reinforcing rings and stringers. Using these relations in an energy approach, methods are developed for determining the resonant frequencies of simply-supported conical shells in unstiffened, ring-stiffened, or ring-and-stringer-stiffened configurations. The stiffeners may be either widely-separated or closely-spaced. Results obtained using these methods are compared with experimental data available in the literature for unstiffened and ring-stiffened shells and data collected in tests of ring-stiffened and ring-and-stringer-stiffened conical shells. Author (TAB)

N68-30362# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE DEVELOPMENT OF THE THEORY OF THIN WALLED CONSTRUCTIONS IN ESTONIAN SSSR[O RAZVITII TEORII TONKOSTENNYKH KONSTRUKTSIY V ESTONSKOY SSR]
Kh. Laul 22 Aug. 1967 22 p refs Transl. into ENGLISH from Izv. Akad. Nauk Eston. SSR, Ser. Fiz.-Mat. i Tekhn. Nauk (Tallinn), no. 3, 1965 p 319–327
(FTD-HT-66-571; AD-669519)

The development of the theory and design of thin-walled structures started in the Estonian SSR in 1945, after the war, and is associated with the name of N. Alumyae. The review is divided into three sections: (1) Theory of elastic and plastic stability and equilibrium of shells and plates; accuracy analysis of the theory. (2) Dynamics of shells and plates; accuracy analysis of engineering theories in plate and shell dynamics. (3) Experimental studies of plate and shell strength under static loads. A brief account of developments in all these aspects of the field of shell and plate design is presented by combining short critical annotations on a majority of 88 items of a list of publications by Estonian authors.
Author (TAB)

N68-30409# Southwest Research Inst., San Antonio, Tex.
NONDESTRUCTIVE EVALUATION OF METAL FATIGUE Scientific Report, 1967–1968
Felix N. Kusenberger, Byron E. Leonard, P. H. Francis, John R. Barton, and W. Lyle Donaldson Apr. 1968 75 p refs
(AFOSR-68-1162; AD-669926)

The purposes of this program effort were twofold: (1) to continue nondestructive fatigue instrumentation studies using the existing fatigue evaluation facility. These studies included the investigation of two new materials of current engineering interest, and (2) to initiate fatigue crack propagation studies with small fatigue cracks developed from the virgin state of the material using the existing nondestructive instrumentations as early crack detection devices. Photographs of the fatigue evaluation facility are shown, and a brief description of the fundamentals of the ultrasonic, magnetic perturbation, and electric current injection techniques is presented. The results obtained from magnetic perturbation and ultrasonic surface wave instrumentations used to monitor stress cycled specimens fabricated from 4340 and maraging steels are presented and discussed. Author (TAB)

N68-30438# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
OSCILLATION OF A CYLINDRICAL SHELL IN A FLOW OF AN IDEAL FLUID [KOLEBANIYA TSILINDRICHESKOY OBOLOCHKI V POTOKE IDEAL'NOY ZHIDKOSTI]
A. N. Volkov 12 Sep. 1967 14 p refs Transl. into ENGLISH from Sb. Tr. Kafedry Stroit. Mekhan. Inzh.-Stroit. Inst. (USSR), no. 27, 1957 p 3–11
(FTD-HT-67-218; AD-670298)

An examination was made of the transverse vibrations of a short cylindrical shell in a potential three-dimensional flow of a perfect fluid. The velocity potential of the flow within a tube (shell) and the pressure of the fluid on the walls of the shell are determined. The author utilizes the expression for the pressure on the walls of the shell to integrate the system of differential equations that describes the deformed state of a shell with hinge-supported ends and determines the frequency of the transverse vibrations of the shell for a special case of zero flow velocity. The results obtained afford a means for the approximate estimation of the influence of the entrained fluid mass on the vibrational frequency of a shell. In conclusion a case is examined in which the fluid flow is outside the shell. In that case also, an approximate formula is obtained for the frequency of vibration. Author (TAB)

N68-30485*# Avco Corp., Wilmington, Mass. Missiles, Space, and Electronics Group.
FEASIBILITY STUDY AND MODEL DEVELOPMENT FOR A FERROFLUID VISCOUS DAMPER Final Report, 8 Nov. 1966 – 8 Mar. 1967
8 Mar. 1967 234 p refs
(Contract NAS5-9431)
(NASA-CR-94173; AVSSD-0222-67-CR; AD-827495) CFSTI: HC $3.00/MF $0.65 CSCL 22B

A damper, or energy dissipation device, is required on the RAE Satellite to reduce the oscillatory motions induced in the satellite by its gravity gradient stabilization system and by disturbance torques. Damping is achieved by flexibly coupling a boom to the satellite through a dissipative element. The damper boom and its coupling system must have a natural frequency of oscillation which differs from that of the satellite, in order for relative motion to take place. Energy can then be taken out of the system at a rate proportional to the relative angular velocities of the boom and satellite and to the damping constant of the dissipative element. Given the proper natural frequencies and a damping coefficient within the specified bounds, the satellite motion can be held within required limits. Author (TAB)

N68-30494# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
CONTRIBUTION TO THE STUDY OF A SEMI-AUTOMATIC METHOD FOR THE APPROPRIATION OF THE EXCITATION FORCES IN AIRPLANE GROUND VIBRATION TESTS [CONTRIBUTION A L'ETUDE D'UNE METHODE SEMI-AUTOMATIQUE D'APPROPRIATION DES FORCES D'EXCITATION DANS L'ESSAI AU SOL D'UNE STRUCTURE D'AVION]
Alphonse Deck 1968 90 p refs
(ONERA-NT-129)

Following a brief survey of the vibration tests by the global method, the theoretical possibility of separating a vibration natural mode in a complex structure is examined. The practical problem for separating a mode, as well as the critical analysis of the existing appropriation methods are discussed. The theoretical and experimental study of a systematic iteration method of appropriation of the excitation is exposed. This method leads to the determination of the excitation forces separating a mode at its natural frequency, as well as to the determination of this frequency. Finally, the project of a set up which should make operational the process studied is exposed as well as the study of a method for analysing the response of the structure by means of a synchronous sampling of this response. The central component of this set up is constituted by a digital computer of the industrial type. Author

N68-30496# California Univ., La Jolla. Aerospace and Mechanical Engineering Sciences Dept.

NON-EXISTENCE OF SNAP-THROUGH FOR CLAMPED, SHALLOW ELASTIC ARCHES SUBJECTED TO IMPULSIVE LOADING

B. Vahidi Mar. 1968 24 p refs

(Grant AF-AFOSR-1226-67)

(TR-8; AFOSR-68-0770; AD-670177)

The problem of dynamic snap-through instability of the elastic clamped shallow arches was re-examined. The governing equation for the corresponding static problem was solved, and it was proved that for ideal impulsive loading there exists no other symmetric or assymmetric static equilibrium configurations, aside from the original undeformed position. Hence, it is considered that contrary to previous analyses, clamped shallow arches under impulsive loading are always stable against snap-through. Author (TAB)

N68-30505*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

EXPERIMENTAL STUDY OF VERTICAL IMPACTS OF AN LM-TYPE LANDING GEAR ASSEMBLY UNDER SIMULATED LUNAR GRAVITY

John Locke McCarty and Huey D. Carden Washington Aug. 1968 55 p refs

(NASA-TN-D-4711) CFSTI: HC $3.00/MF $0.65 CSCL 22B

A study made to evaluate the response of a landing gear system on several penetrable target materials and to relate this response to that of penetrometers impacting the same materials. Testing included vertical impacts of a single landing gear unit at velocities up to approximately 3 m/sec. The test apparatus included a full-scale boilerplate pad and a vertical strut with stroking characteristics similar to those of LM. The mass of the system approximated 25, 50 and 100% of the anticipated vehicle landing mass. The target materials consisted to two grades of quartz sand (one in a densely packed state) and an open cell urethane foam. The results show that the maximum anticipated accelerations sensed by the vehicle occupants and equipment would not exceed 3.3g (earth) in a vertical landing. During strut compression, which is intensified with increasing target bearing strength, with system mass and with impact velocity, these accelerations are shown to be a function of only the crushing strength of the collapsible strut and the system mass. Pad accelerations increase with increasing impact velocity and increasing target penetration resistance and, during strut compression, are independent of the system mass. Data are presented which show that the penetration of the landing pad into particulate target materials can be reasonably estimated. Author

N68-30558# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

STABILITY OF A HINGE-SUPPORTED RECTANGULAR PLATE LOADED IN ITS PLANE WITH A LOCAL LOAD [STIYKIST' SHARNIRNO OPERTOYI PRYAMOKUTNOYI PLASTYNKY PID LOKAL'NYM NAVANTAZHENNYAM]

N. A. Peklov 29 Aug. 1967 12 p refs Transl. into ENGLISH from Dopovidi Akad. Nauk Ukr. RSR (Kiev), no. 1, 1966 p 58–63

(FTD-HT-67-126; AD-670063)

The buckling of a rectangular plate by a local load acting in the plane of the plate is analyzed. A load uniformly distributed along a small, but finite section of the edge is used instead of a concentrated load. The problem is treated as a linear one, and two methods are used in determining the buckling load which depends on the value of a buckling coefficient K: (1) integration of the partial differential equation (which describes the shape of the elastic surface at the instant of buckling) by a finite-difference method; and (2) the energy method. The values determined by method (1) are lower than the exact values, and the values determined by method (2) are higher than the exact values. The maximum difference between them is less than 2%. Results of calculating a numerical example (carried out on the Kiev electronic computer) by both methods are given in tables. Author (TAB)

N68-30564# Polytechnic Inst. of Brooklyn, N. Y. Dept. of Aerospace Engineering and Applied Mechanics.

AXISYMMETRIC ELASTICITY SOLUTIONS OF SPHERICAL SHELL SEGMENTS

Howard S. Levine and Jerome M. Klosner May 1968 79 p refs

(Contract Nonr-839(40))

(PIBAL-68-12; AD-669983)

An exact series solution for the stresses and displacements of a spherical segment subjected to arbitrary axisymmetric surface tractions and edge boundary conditions is presented. The general solution for the axisymmetric case has been obtained by utilizing two sets of functions, namely, the Lure homogeneous functions and the full sphere functions used by Sternberg, Eubanks and Sadowsky. In particular, solutions to the following problems have been obtained: (a) the spherical segment with a stress free edge subjected to a centrifugal force field; (b) the spherical segment subjected to an external pressure varying as cos(2N)theta supported on a rigid surface with no shear resistance; (c) the hemisphere having zero traction on its spherical surfaces subjected to edge shear stresses. The results are presented in graphic form, which demonstrates the boundary layer effect. Heretofore, solutions to these types of problems have been obtained by using shell theory approximations. Author (TAB)

N68-30578*# Battelle Memorial Inst., Columbus, Ohio.

EVALUATION OF EXPERIMENTAL AND THEORETICAL DATA ON RADIAL NOZZLES IN PRESSURE VESSELS

E. C. Rodabaugh, T. J. Atterbury, R. L. Cloud (Bettis Atomic Power Lab., Pittsburgh), and F. J. Witt (Oak Ridge Natl. Lab.) [1967] 239 p refs Sponsored in part by NASA Prepared jointly with Bettis Atomic Power Lab., Pittsburgh and Oak Ridge Natl. Lab., Tenn.

(Contract W-7405-ENG-92)

(NASA-CR-95896; TID-24342) CFSTI: HC $3.00/MF $0.65 CSCL 13K

Included in six sections are data on radial nozzles in pressure vessels. The first three sections are on nozzles in spherical shells. The last three sections are on nozzles in cylindrical shells. Sections 1 and 4 contain proposed design procedures for nozzles with internal pressure loading. These two sections also contain a brief description of the development of the design procedures and comparisons with other design procedures. Sections 2 and 5 cover external loadings as well as internal pressure. Comparisons are made between a number of theories and between those theories and test data. Section 2 includes an Appendix giving graphs for obtaining stresses for nozzles in spherical shells due to internal pressure, external loads or combinations thereof. Section 5 includes an Appendix giving tables of stresses for nozzles in cylindrical shells due to internal pressure loading. Sections 3 and 6 cover the subject of flexibility of nozzles in pressure vessels. The flexibility

of the nozzle is significant where the nozzle is attached to a piping system and the external loads on the nozzle arise from piping expansion. Author (NSA)

N68-30653#
SHIELDING SHELLS FROM THE EFFECT OF PULSE LOADING
E. A. Limberg 1968 4 p refs Transl. into ENGLISH from Samoletostr. i Tech. Vozdushn. Flota (Khar'kov), No. 10, 1967 p 100–103
CFSTI: HC $3.00/MF $0.65

The physical principles of the shielding mechanism of a solid cylindrical shell under pulse loading were studied. Using energy hypotheses as a basis, a method was developed for analyzing the efficiency of using a solid metal shield to protect the wall of a cylindrical shell from the effect of a pulse loading occurring in the instantaneous liberation of energy. The proposed method uses an acoustic approximation to determine the shielding properties. The combined operation of rings of a shielding and a shielded shell of unit height under the effect of symmetric pulse loading is analyzed to demonstrate the applicability of the proposed approach. S.C.W.

N68-30657
ASYMPTOTIC METHOD IN THE THEORY OF VIBRATIONS OF ELASTIC PLATES AND SHELLS
V. V. Bolotin 1968 5 p refs Transl. into ENGLISH from Izv. Akad. Nauk Kaz. (Kazan), 1961 p 21–26 Presented at Theory of Plates and Shells Conf., Kazan, 24–29 Oct. 1960
CFSTI: HC $3.00/MF $0.65

A general formulation of an asymptotic method to investigate the natural and forced vibrations of plates based on the concept of a dynamic edge effect, and shallow and nonshallow shells with vibration modes possessing high indices of variability is presented. The proposed method is extended to the solution of self-adjoint problems on eigenvalues given in a rectangular domain, i.e., the so-called boundary value problems with quasi-separable variables. S.C.W.

N68-30660
CORRELATION PROPERTIES OF THE FIELD OF PLATE VIBRATIONS UNDER WIDEBAND RANDOM LOADING
V. A. Pal'mov 1968 5 p refs Transl. into ENGLISH from Inzh. Zh., Mekh. Tverdogo Tela (Moscow), No. 5, 1967 p 136–140
CFSTI: HC $3.00/MF $0.65

Forced vibrations of plates subjected to a distributed random loading are considered. It is assumed that the loading is a wideband random process, and the plate dimensions are large as compared to the distance of the pressure field correlation. A general expression is obtained for the spatial correlation spectrum of the vibration field in the form of a single integral over a finite domain. The integral is evaluated for the following two kinds of loading: (1) a surface loading generating a statistically isotropic random field; and (2) a surface loading generating an arbitrary homogeneous statistically anisotropic random field. S.C.W.

N68-30661
ON LONGITUDINAL VIBRATIONS OF PRISMATIC RODS FABRICATED FROM MATERIAL OF A DIFFERENT MODULUS
A. A. Khachatrian 1968 8 p refs Transl. into ENGLISH from Inzh. Zh., Mekh. Tverdogo Tela (Moscow), No. 5, 1967 p 140–145
CFSTI: HC $3.00/MF $0.65

Longitudinal vibrations of constant cross section rods fabricated from material of a different elastic modulus characterized by the elastic moduli E+ and E− under tension and compression, respectively, are considered. The hypothesis of plane sections is used in the study of the longitudinal rod vibrations, and particle motions perpendicular to the rod axis are neglected. In the analysis the following two specific problems are considered: (1) the free longitudinal vibrations of a rod of length l, having one end fixed (x = 0), the other end free (x = 1); and (2) the vibrations of a rod moving along the x axis with the constant velocity v, whose end (x = 0) is suddenly stopped. S.C.W.

N68-30666# North Carolina State Coll., Raleigh. Dept. of Mechanical Engineering.
VIBRATIONS OF CURVED BEAMS
L. H. Royster May 1968 47 p refs
(Contract Nonr-486(11))
(AD-669493)

A review of the literature pertaining to the free and forced vibrations of curved beams is presented herein. The literature is partitioned into two categories; namely, (1) Vibrations in the Plane of Initial Curvature, and (2) Vibrations out of the Plane of Initial Curvature. Representative results of various investigations are presented, and comparisons are noted between the theoretical and experimental data wherever possible. Author (TAB)

N68-30691# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
BOUNDS TO BENDING FREQUENCIES OF NON-UNIFORM SHAFTS, AND APPLICATIONS TO MISSILES
Nathan Rubinstein, Vicent G. Sigillito, and James T. Stadter Feb. 1968 76 p refs
(Contract NOw-62-0604)
(TG-966; AD-669997)

Non-uniform shafts can be used as models for the analysis of missile vibrations. Digital programs that can calculate the upper and lower bounds to frequencies of bending vibration of such free, non-uniform shafts and can accept input data in standard engineering units have been developed. How the programs are used (i.e., input/output data packages), underlying theory and its application to the programs, a description of the programs themselves, and the principal subroutines of the programs are presented. FORTRAN listings for both upper and lower bounds, along with sample printouts of both, are included. Improvements over other existing programs, offered by these programs are that they: (1) give upper and lower bounds that bracket the true frequencies, (2) are computationally fast and accurate, (3) can handle a large number of non-uniformities, and (4) can be easily extended to handle shafts that have more complicated variations of stiffness and mass than those presented. Author (TAB)

N68-30813# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
METHOD FOR OBTAINING THE NATURAL MODES BY CALCULATION OF THE OPTIMUM HARMONIC EXCITATION BASED ON THE CRUDE RESULTS OF VIBRATION TESTS [METHODE DE RECHERCHE DES MODES PROPRES PAR CALCUL DE L'EXCITATION HARMONIQUE OPTIMUM D'APRES LES RESULTATS BRUTS D'ESSAIS DE VIBRATIONS]
Daniel Clerc 1967 58 p refs In FRENCH; ENGLISH summary /ts Note Tech. No. 119
CFSTI: HC $3.00/MF $0.65

The precise research of the natural modes of an elastic structure by means of vibrations test using harmonic excitation sometimes presents serious difficulties, particularly in the case of distinct natural forms of neighbouring frequencies. The success of the operation depends essentially on the more or less correct adaptation of the excitation forces to the natural modes that we try to determine. It is shown that this adaptation is more and more precise as the number of exciters increases; but we find that the

exact forces become more and more difficult to evaluate since the usual way to proceed consist in an empirical determination. The present method aims, among other things, at over-coming this disadvantage by substituting to the empirical determination a systematic calculation giving the best adjustment of the forces. This is done in the following manner: during a series of tests we make a dual survey to obtain the frequency and the force adaptation. The results, appropriately recorded, are then introduced in a calculation which gives the precise optimum adaptation and the corresponding response, that is to say the natural form. Then the calculation determines the generalized mass by simulation of a usual process such as that of the forces in quadrature. A numerical application of this method to a simple model is given, the vibrations test having been simulated by a calculation made beforehand. Author

N68-30848# National Research Council of Canada, Ottawa (Ontario).
THE VIBRATION OF STEPPED CANTILEVERED PLATES
G. M. Lindberg Dec. 1967 51 p refs
(LR-494; NRC-10058; AD-669826)

A theoretical and experimental study of seven stepped cantilevered plates is presented. Four of the plates are square, with increasingly severe steps, and the remaining three are non-rectangular, formed by removing parts of the outboard corners. The first nine natural frequencies and mode shapes of each of the plates are found experimentally and are compared with results predicted using two different approximate finite element representations. It is found that a relatively coarse gridwork of finite elements (4 elements x 4 elements) will predict frequencies with an accuracy of better than 5 percent and also accurately predict mode shapes. There appears to be little difference between the results predicted using the two different methods. The energy models predict frequencies slightly closer to the experimental ones, but only the Hrennikoff model can be used to solve the non-rectangular problems. The present study serves to illustrate further the power of finite element techniques. Author (TAB)

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N68-29626 Utah Univ., Salt Lake City.
ISOTHERMAL DECOMPOSITION OF SECONDARY EXPLOSIVES BY AN AUTOMATIC BALANCE TECHNIQUE
David Earl Richardson (Ph. D. Thesis) 1967 102 p
Available from Univ. Microfilms: HC $5.20/MF $3.00 Order No. 67-12359

Thermogravimetric solid decomposition for open air and continuous vacuum tests on isothiocyanatopentammine cobalt (III) perchlorate were analyzed by a geometric model based upon growing spherical nuclei and burning sphere relations. This model assumes that the reaction rate is proportional to the product–reactant interfacial area. The thermogravimetric curves for tests in the open air exhibited a complex shape with two sigmoidal regions, indicating at least two consecutive reactions; however, the curves obtained from decomposing samples under continuous vacuums showed a single sigmoidal shape. The thermogravimetric curves for hexanitroazobenzene were linear, obeyed zero-order kinetics, and in the open air had an activation enthalpy of 40 kcal/mole. Minor differences in thermogravimetric results for two samples differing in purity and particle size were found. Dissert. Abstr.

N68-29659# Tulane Univ., New Orleans, La. Mechanical Engineering Dept.
VARIOUS STUDIES OF JET FLAMEHOLDERS Final Report
John R. O'Loughlin Jun. 1968 19 p refs
(Contract DA-31-124-ARO(D)-240)
(AROD-4981.7-E; AD-669634)

The overall objective of the research was to obtain a better understanding of the characteristics of jet flameholders. Both experimental and analytical studies were conducted in order to achieve this end. The overall objective was subdivided into two research areas as follows: (1) Studies of the mechanism of flame stabilization. (2) Studies of the flame downstream of the flame stabilization region. Author (TAB)

N68-29703 North Carolina State Coll., Raleigh.
ENGINEERING DESIGN OF THE HEAT PIPE
John Howard Cosgrove (Ph. D. Thesis) 1967 99 p
Available from Univ. Microfilms: HC $5.00/MF $3.00 Order No. 67-11270

Mechanisms involved in the operation of a self-contained heat transfer device, the heat pipe. A typical configuration for this device is a long closed pipe having its inner wall lined with a liquid saturated wick. One end is heated and the other cooled. The liquid in the wick at the heated end vaporizes, flows to the cool end where it condenses, and then is returned to the heated end by capillary action. Two experimental heat pipes were constructed and instrumented so that their operating characteristics could be accurately and precisely defined at all levels. An analytical study was also made based on the assumption that capillary circulation was the controlling factor in heat pipe operation. The analytical model was based on fundamental mass, heat, and momentum balances in the wick. It related the maximum heat input to the fluid and wick characteristics and to the indiclindation of the pipe with respect to gravity. The model indicated that the critical parameters and operating characteristics were the capillary forces in the wick, pressure drop through the wick, and the operating temperature of the heat pipe. The developed model can be used to determine the operating limits of a capillary controlled heat pipe. Author

N68-29711# Argonne National Lab., Ill.
CONVECTIVE HEAT TRANSFER BETWEEN THE SURFACE AND THE BED OF MOVING PARTICLES [O KONVEKTIONOM TEPLOOBMENE MEZHDU POVERKHNOST'YU I SLOEM DVIZHUSHCHIKHSYA CHASTITS]
Ya. P. Shlapkova and V. D. Dunskii Mar. 1968 10 p refs Transl. into ENGLISH from the book "Issledovanie Teplo i Massoobmena v Tekhnologicheskikh Protsessakhi Apparatakh" Minsk, Nauka i Tekhnika Publ. House, 1966 p 55–59
(ANL-Trans-586) CFSTI: HC $3.00/MF $0.65

Heat transfer measurements were made in a model of a moving fluidized bed. The bed material consisted of particles of slag and sand with a mean diameter for the slag particles of 0.78, 1.2, and 2.2 mm, and 0.25 and 0.36 mm for the sand particles. Measurements of the heat transfer coefficients were made with a stationary heat flow from a heater to cooler through the bed. The effects of stirring speed and air flow velocity were measured. The results showed that: although it is possible to reach high heat transfer coefficients in stirred beds, still a considerable increase in this coefficient is observed when the velocity of air filtration through the bed reaches the velocity of the beginning of fluidization; that the convective component can be disregarded for fine particles (smaller than 1.0 mm dia) at atmospheric pressure; and that for large particles (2 to 3 mm dia) the convective component at atmospheric pressure does not exceed 15% of the total heat transfer coefficient. NSA

N68-29782 Case Inst. of Tech., Cleveland, Ohio
SIMILARITY STUDIES ON THE RADIATIVE GAS DYNAMIC EQUATIONS
James Richard Anthony John NiCastro (Ph. D. Thesis) 1966 151 p
Available from Univ. Microfilms: HC $7.20/MF $3.00 Order No. 67-11564

Spherically symmetric similarity solutions of the radiative gas dynamic equations are examined for problems of imploding and exploding shock waves. The system is reduced to similarity form by retaining the definitions of the radiant quantities as operators on the radiative intensity. Homology structure for the intensity is dictated by the governing equations. It is shown that stipulating a radiative transfer law constitutes a simple constraint on the system. Large classes of radiative transfer laws are compatible with a constant shock strength or with a limitingly strong shock. Because of radiative heating, similarity structure may be prescribed for the gas upstream as well as downstream of the shock wave. Constant shock strength is maintained by virtue of identical similarity homology in both regions. The general Rankine-Hugoniot equations for an arbitrary radiative intensity are given. In the adiabatic problem, the solution for the velocity distribution is not contingent on the form of the radiative intensity. Computations are effected illustrating useful approximation schemes.
Dissert. Abstr.

N68-29782 Rensselaer Polytechnic Inst., Troy, N. Y.
MATHEMATICAL TREATMENT OF THERMODYNAMIC DATA FOR SOLUTIONS
Ronald Louis Klaus (Ph.D. Thesis) 1967 283 p
Available from Univ. Microfilms: HC $12.85/MF $3.65 Order No. 67-12837

Two unique sets of orthogonal polynomials are presented for the representation of partial and total thermodynamic excess functions for binary systems. Numerical methods are developed to permit application to experimental data. The spline fit technique is extended so as to permit the smoothing of experimental data. It is applied to thermodynamic data which are otherwise difficult to treat. Rigorous equations are derived which permit the calculation of the composition of the vapor phase in equilibrium with a multicomponent liquid phase from a knowledge of the total vapor pressure of the system.
Dissert. Abstr.

N68-29784 Polytechnic Inst. of Brooklyn, N. Y.
THERMAL STRATIFICATION IN CLOSED, CRYOGENIC SYSTEMS
Sin Chou Fan (Ph. D. Thesis) 1967 124 p
Available from Univ. Microfilms: HC $6.00/MF $3.00 Order No. 67-10936

The thermal stratification in liquid nitrogen was investigated by varying the heat flux from 1.8 to 67 BTU per hour per square foot and the liquid level in vessel from 70 to 100 per cent full. The study was conducted at various pressures up to the critical point. It was found experimentally that, when the vessel shell was exposed to a higher heat flux, the contents tended to stratify along the vertical direction. The horizontal thermal gradients were not measurable, even near the wall of the vessel. If the shell heat flux is low, the free convection currents or the stream flow in the bulk liquid is small. The downward heat flow from the vapor-liquid interface is assumed mainly by conduction. Based on Duhamel's theory, the heat conduction equation was solved, with a time-dependent boundary condition. For a definite heat flux and liquid mass, temperature is a function of time and depth. The resulted temperature profiles are in good agreement with the experimental data.
Dissert. Abstr.

N68-29790 West Virginia Univ., Morgantown.
A GENERALIZED VARIATIONAL FORMULATION FOR NON-EQUILIBRIUM THERMODYNAMICS BASED ON FLUCTUATION THEORY
Walter Steven Chmielewski (Ph. D. Thesis) 1966 106 p
Available from Univ. Microfilms: HC $5.40/MF $3.00 Order No. 67-10845

The work of Prigogine and Glansdorff is extended, and a general variational furmulation is derived to include time dependent fluid flow problems with viscous dissipation, heat conduction and arbitrary temperature dependent coefficients. Fluctuation theory is applied to the methods of irreversible thermodynamics and the concept of the local potential by splitting the temperature and velocity into average and fluctuating components. The principles of classical variational calculus are then applied to the fluctuating components in a self-consistent manner. The method is an application of classical variational calculus principles to non-self-adjoint problems. A main feature of the variational formulation is that the Euler equations operating on the functional, retrieve the conservation equations of momentum and energy. Thus, the variational problem is amenable to solution by such direct principles as the Rayleigh-Ritz method.
Dissert. Abstr.

N68-29799 Washington Univ., Seattle.
THE THERMODYNAMIC AND OPTICAL PROPERTIES OF AN ANHARMONIC DIATOMIC LATTICE
George Earl Jelinek (Ph. D. Thesis) 1967 151 p
Available from Univ. Microfilms: HC $7.20/MF $3.00 Order No. 67-9910

The thermodynamic properties of a model of the solidified diatomic gases have been calculated. The assumed structure involves cubic close-packing of cylinders and the effects of the harmonic and cubic potential are considered. The Born and Huang approach to the problem of the anharmonic contribution to the thermodynamic properties has been used; the method consists in treating the anharmonic terms in the potential energy expansion as a perturbation. The heat capacity, thermal expansion, compressibility, and X-ray temperature factors of the model have been calculated from a basis set of 512 points in the full Brillouin zone. An analysis of the infra red spectrum of β oxygen indicates that the lattice combination band centered 69 cm^{-1} above the fundamental frequency is a vibration-translation of the type longitudinal optic + longitudinal acoustic as concluded by Cairns and Pimentel. The extreme low frequency end of the spectrum of indium was calculated for a tensor force model considering interactions of an atom with its first- and second-nearest neighbors.
Dissert. Abstr.

N68-29819# Argonne National Lab., Ill.
EXPERIMENTAL STUDY OF THE HEAT TRANSFER BETWEEN A PULSATING BED AND THE HEATING SURFACE
I. A. Bokun and S. S. Zabrodskii Mar. 1968 10 p refs Transl. into ENGLISH from the book "Issledovanie Teplo-I Massoobmena v Tekhnologicheskikh Protessakh i Apparatakh" Minsk, Nauka i Tekhn., 1966 p 27-32
(ANL-Trans-592) CFSTI: HC $3.00/MF $0.65

An investigation was undertaken to determine and compare heat transfer coefficients of a pickup after its immersion in a pulsating bed and in a usual fluidized bed of dry sand. A pulsating bed is defined as the state of a dispersed solid material which is penetrated by a pulsating gas current which suffices in order to force the bed into motion. The details of the experimental procedure are described. The bed was composed of dry quartz sand of varying mean diameters from 0.18 to 0.815 mm. The experiments showed that the maximum coefficient of heat transfer between the pulsating bed and the pickup and also between the latter and the fluidized bed is practically equal and is described by the formula $\alpha_{CT \cdot Max} = 35.7\, \rho_M^{0.2}\, \lambda^{0.6}\, d_\Gamma^{-0.36}$ with an accuracy of ±15%. (ρ_M = density of granular material, λ_Γ = coefficient of heat conductivity of the gas.

and d = particle diameter.) Such a closeness of $\alpha_{CT \cdot Max}$ can be explained by the great similarity between the heat transfer mechanisms of the pulsating and of the inhomogenous fluidized bed. The best heat transfer is obtained in both cases by the contact of the heating surface with the highly concentrated bed of particles which interchange rapidly near the surface. NSA

N68-29820# Argonne National Lab., Ill.
HEAT TRANSFER BETWEEN A PULSATING BED OF MOIST TETRACYCLINE AND THE HEATING SURFACE
S. S. Zabrodskii and I. A. Bokun Mar. 1968 10 p refs Transl. into ENGLISH from the book "Issledovanie Teplo-i Massoobmena v Tekhnologi Cheskikh Protessakh i Apparatakh" Minsk, Nauka i Tekhn., 1966 p 135-139
(ANL-Trans-593) CFSTI: HC $3.00/MF $0.65

Experiments were performed to determine the heat transfer coefficients of a pulsating bed of moist tetracycline with a low temperature heating surface. Application of a pulsating bed method of drying tetracycline is important because only a low temperature of the drying agent is permitted, and such a method could be mechanized and automated resulting in a more sanitary drying process. A grid was covered with a tetracycline bed aproximately 185 mm high. An electric heater with a constant 80°C surface temperature was located in the center of the bed. Air flowed through the bed and grid at pulsation frequencies varying from 0 (steady air current) to 2 Hz. It was found that the heat transfer coefficient increased with increasing air filtration speed and that the optimum pulsation frequency was between 1 and 1.5 Hz. The experiments confirmed that a sharp intensification of the drying of tetracycline occurs at the transition from the steady passage of air to the pulsating flow. The quality of the material dried was satisfactory, and this quality could be further improved by appropriate control of the heating surface. NSA

N68-29821# Argonne National Lab., Ill.
SOME PECULIARITIES OF HEAT TRANSFER BETWEEN A THIN FLUIDIZED BED AND A SURFACE IMMERSED IN THE BED
V. I. Yuditskii and S. S. Zabrodskii Mar. 1968 14 p refs Transl. into ENGLISH from the book "Issledovanie Teplo-i Massoobmena v Tekhnologicheskikh Protessakh i Apparatakh" Minsk, Nauka i Tekhn., 1966 p 19-26
(ANL-Trans-587) CFSTI: HC $3.00/MF $0.65

Approximately 150 experiments were carried out to measure the heat transfer coefficients of a horizontal cylinder in the zone of a thin fluidized bed near a grid. Thin layers of sand (0.30 to 1.61 mm dia), of copolymer MSN (0.71 mm dia), and of the CO-conversion catalyst (0.71 mm dia) were fluidized by air at room temperature on a grid with holes of 1.65 mm dia. A cylindrical heating wire of 15.5 mm dia was used as the heat transfer surface. The initial height of the bed was 35 or 70 mm, and the air flow through it was varied from 0.5 to 4.0 m/sec. The effects of each of these variables on the heat transfer coefficient of the wire in the thin fluidized bed are presented quantitatively in graphic form. NSA

N68-29845#
INFLUENCE OF AN ELECTRIC FIELD ON VIBRATIONAL COMBUSTION OF PROPANE
S. A. Abrukov, V. V. Kurzhunov, and V. N. Mezdrikov [1968] 4 p refs Transl. into ENGLISH from Fiz. Goreniia i Vzryva (USSR), no. 2, 1968 p 68-71
CFSTI: HC $3.00/MF $0.65

Influence of electric fields on the vibration combustion modes of propane fuel was investigated, with the flame front considered a unique element permitting an electric field to affect the stability of a hydrodynamically unstable vibrational system. Both direct and alternating field, considered in relation to the diffuse and kinetic "humming" of a propane flame, were found to influence the vibrational combustion of gas mixtures. Several stability domains caused by the effect of the external field were observed in the diffusion combustion mode; and these domains depended on the flame's position in the resonator tube cross section. Quenching potential was maximum for a tongue near the tube axis. Under identical experimental conditions, quenching potentials for the diffusion and kinetic flames were different. The direct electric field exerted no influence on the frequency of vibrational combustion. The alternating field also suppressed acoustic oscillations, although forced acoustic oscillations occured at the frequency of the alternating field modulated by strong low frequency pulsations whose amplitude decreases as the potential applied to the electrode drops. M.W.R.

N68-29870*# National Bureau of Standards, Boulder, Colo. Inst. for Basic Standards.
COMPUTER PROGRAMS FOR SATURATION PROPERTIES OF HYDROGEN
R. D. McCarthy 25 Jun. 1968 11 p *Its* Suppl. to NBS Rept. 9288
(NASA Order R-45)
(NASA-CR-95831; NBS-9711) CFSTI: $3.00 CSCL 20M

The pressure, temperature and enthalpy of saturated liquid and vapor parahydrogen are presented in the form of two computer programs. With these two routines and those in NBS Report 9288, "Computer Programs for Thermodynamic and Transport Properties of Hydrogen," August 18, 1967, it is possible to obtain values of the saturated liquid and the saturated vapor for all of the properties given in NBS Report 9288 (density, entropy, thermal conductivity, viscosity, specific heat and sound velocity). Author

N68-29874# Purdue Univ., Lafayette, Ind. Jet Propulsion Center.
EXPERIMENTAL BURNING RATES AND COMBUSTION MECHANISMS OF SINGLE BERYLLIUM PARTICLES
Andre J. Macek (Atlantic Res. Corp.) and J. Mc Kenzie Semple (Atlantic Res. Corp.) Mar. 1968 28 p refs Presented at the 12th Intern. Symp. on Combust.
(Contract N00014-67-A-00226-0005; Proj. Squid)
(ARC-11-PU; AD-669489)

Single spherical beryllium particles from two powder samples having average particle diameters of 32 microns and 25 microns respectively were injected into oxidizing gases, both moist and dry, at atmospheric pressure and at temperatures ranging from 2600 to 2950K. The purpose was accurate measurement of metal burning rates and a study of parameters affecting these rates. Ignition efficiencies, burning rates, and flame diameters of particles were found to vary both with particle diameters and with ambient gas properties. It is concluded that beryllium particles may burn by several distinct modes. One is rapid vapor-phase diffusion flame, favored by high partial pressures of oxygen and high temperatures of the gaseous environment. The burning times corresponding to this mode, measured with accuracy of plus or minus 0.1 msec and ranging from 1.3 to 4.5 msec, were found to be proportional to the square of the particle diameter and inversely proportional to a power of oxygen pressure slightly less than unity. As the partial pressure of oxygen is decreased below a certain value which is usually between 0.1 and 0.2 atm, the metal flame temperature decreases and vapor-phase combustion gradually changes over into slow surface reaction. There is also evidence of a third mode in which combustion is only moderately slower than the rapid vapor-phase burning. This mode, favored by low temperature and by the presence of water vapor in the environment, may be vapor-phase combustion hindered by a heavy coating of beryllia accumulated on the particle during the pre-ignition surface reaction. Author (TAB)

N68-29900 Virginia Polytechnic Inst., Blacksburg.
AN INVESTIGATION INTO THE EFFECTS OF VARIOUS PLATINGS ON THE FILM COEFFICIENT DURING NUCLEATE BOILING FROM HORIZONTAL TUBES
Frank E. Bliss, Jr. (Ph. D. Thesis) 1967 166 p
Available from Univ. Microfilms: HC $7.80/MF $3.00 Order No. 67-11368

Nucleate boiling is a process characterized by high rates of heat flux occurring at relatively small temperature differences between the surface upon which the boiling is taking place and the liquid being boiled. Many researchers have noticed that the material of the heating surface appears to have a considerable effect on the surface temperature required for a given rate of heat transfer. However, no attempt has been made to single out this effect by holding all of the other variables constant. It was the purpose of this work to do precisely that. The experimental portion of this investigation consisted of running tests on plated and unplated stainless steel tubes. The .0005 inch thick platings chosen for these tests were copper, tin, cadmium, zinc, nickel, and chromium. Since, of all the materials tested, the thermal properties of the copper are more favorable for heat transfer, the analytical solution was applied to this material. The analytical solution shows that, for the thickness of copper plating used, the thermal properties of the plating can account for about 16 per cent of the increase in the heat flux, at a given surface temperature, of the copper surface over the bare stainless steel surface. However, the analytical solution indicates that for much thicker platings the thermal properties of the platings would become more important. Dissert. Abstr.

N68-29924*# Tennessee Univ., Tullahoma. Space Inst.
AN INVESTIGATION OF RADIATIVE HEAT TRANSFER IN ABSORBING, EMITTING, AND SCATTERING MEDIA
F. Shahrokhi and P. Wolf [1968] 35 p refs
(Grant NGL-43-001-021)
(NASA-CR-95838) CFSTI: HC $3.00/MF $0.65 CSCL 20M

The problem of radiative heat transfer in a nonisothermal medium is considered. The analysis is carried out for the plane, spherical, and cylindrical geometries separated by a cloud of particles. The media are assumed composed of spherical particles of uniform diameter and complex refractive index which emit, absorb, and scatter energy in an anisotropic fashion. The solution of the equation of transfer for the aforementioned media is obtained by finite-difference iteration method. Author

N68-29965 California Univ., Berkeley.
VARIATIONAL PRINCIPLES AND APPROXIMATE METHODS IN LINEAR COUPLED THERMOELASTICITY
Robert Ernest Nickell (Ph. D. Thesis) 1967 121 p
Available from Univ. Microfilms: HC $6.00/MF $3.00 Order No. 67-11652

Several variational principles are derived for the initial-boundary-value problem of fully coupled linear thermoelasticity for an inhomogeneous, anisotropic continuum. A consistent set of field variables is employed and a method based on the Laplace transform is used to incorporate the initial conditions explicitly into the formulation. A technique is then developed for obtaining approximate solutions. This procedure is a direct variational approach representing an extension of the Ritz method. As an illustration of the procedure, application is made to a class of essentially one-dimensional, transient problems involving weak thermal shocks. The problems considered are: (1) rapid heating of a half space through a thermally conducting boundary layer, and (2) gradual heating of the boundary surface of a half space. The solutions generated by the extended Ritz method are compared for accuracy, to solutions obtained from a numerical inversion scheme for the Laplace transform based on Gaussian quadrature. These comparisons indicate that the variational procedure developed here can yield accurate results. Dissert. Abstr.

N68-29983*# Princeton Univ., N. J. Guggenheim Labs.
NONLINEAR ASPECT OF COMBUSTION INSTABILITY IN LIQUID PROPELLANT ROCKET MOTORS Status Report No. 8, 1 Jun. 1967 – 31 May 1968
L. Crocco, D. T. Harrje, W. A. Sirignano, F. V. Bracco, J. B. Elgin, et al Jun. 1968 132 p refs
(Contract NASr-217)
(NASA-CR-72426; AMS-SR-553-h) CFSTI: HC $3.00/MF $0.65 CSCL 21B

The effect of damping devices on stability is considered, and the flow field associated with an acoustic liner is analyzed. A distinction is made between the near-resonance and off-resonance conditions, and solutions for the off-resonance case are presented. Based on a numerical approach, the acoustic admittance is calculated for several liner design conditions, and a test series was conducted in a rocket chamber environment to determine the optimum circumferential place of acoustic dampers. In cold flow simulation studies of liner behavior, shock-type waves are being generated and damped to assess the damping efficiency with regard to nonlinear waves. Shadow photography is being used to record the events taking place in the cavity, such as the jet-like flow, vortices, and turbulent phenomena. Two sets of equations are developed for computing steady-state combustion parameters using directly measured values of overpressure and velocity of an externally induced shock wave. The effect of tangential spin direction is being investigated as a chemical kinetic effect. Theoretical data are presented on the nonlinear gas dynamic oscillations associated with combustion instability involving shock-type waves in both the tangential and longitudinal modes. M.G.J.

N68-30023# Aerospace Research Labs., Wright-Patterson AFB, Ohio.
A GENERAL COMPUTER PROGRAM FOR EVALUATION OF TEMPERATURE PROFILES AND INTERFACE POSITION IN FILAMENTS UNDERGOING SOLIDIFICATION Final Report, Jan.–Jun. 1967
Milton E. Morrison Apr. 1968 51 p refs
(ARL-68-0064; AD-669329)

A computer program is described for numerical evaluation of temperature profiles and interface position as a function of time for cylindrical filaments undergoing solidification. The method is outlined for cooling and solidification of a moving filament of molten polymer; however, unsteady-state heat transfer in two-phase systems can be studied with the same program. Boundary conditions include the effect of convective and radiative energy losses. The program listing is given in FORTRAN IV. Author (TAB)

N68-30041# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECT OF CARBON DIOXIDE AND WATER VAPOR ON THE INDUCTION PERIOD OF THE HYDROGEN–OXYGEN REACTION
Casimir J. Jachimowski and William M. Houghton Washington Aug. 1968 15 p refs
(NASA-TN-D-4685) CFSTI: HC $3.00/MF $0.65 CSCL 21B

The effect of carbon dioxide and water vapor on the induction period kinetics of the hydrogen–oxygen reaction was studied in a shock tube at temperatures between 1000° and 1500°K. The results show that carbon dioxide does not produce any noticeable effect, whereas water vapor appears to accelerate the hydrogen–oxygen reaction. The analysis of experimental data indicates that the accelerating influence of water vapor is due to two processes. One process is dominant at the higher temperatures, the chain branching reaction $O + H_2O \rightarrow 2OH$, and the other, an unidentified process, is dominant at the lower temperatures. Author

N68-30062 Kansas Univ., Lawrence.
SOLUTIONS OF THE PERCUS-YEVICK EQUATION FOR THE LENNARD-JONES POTENTIAL AND THE STATISTICAL THERMODYNAMICS OF SOME SIMPLE FLUID SYSTEMS
Gerald Joseph Throop (Ph. D. Thesis) 1966 250 p
Available from Univ. Microfilms: HC $11.25/MF $3.25 Order No. 67-10838

Using the Percus–Yevick equation for the radial distribution function and the Lennard–Jones 6-12 potential, we have studied the statistical thermodynamics and the radial distribution functions for various one and two component systems. In Chapter II we discuss the thermodynamic functions for the Lennard–Jones and Percus–Yevick theory at temperatures and densities near the coexistence curve. In Chapter III, the radial distribution functions for a number of binary mixtures have been calculated as a function of the Lennard–Jones parameters and the thermodynamic state. We find that the distances from the central molecules to the peaks of the distribution functions are entirely similar to those in the corresponding hard-sphere systems. The peak heights, however, are considerably different. In Chapter IV, we present the theoretical thermodynamic functions for binary mixtures of Lennard–Jones molecules. The functions presented are the virial and compressibility equations of state, the internal energy, the virial Helmholtz free energy, and the compressibility Gibbs free energy. In addition, we present the excess thermodynamic functions for two mixing processes, constant pressure mixing, and mixing at constant volume density. Dissert. Abstr.

N68-30134# Dynamic Science Corp., Monrovia, Calif.
INVESTIGATION OF MATERIALS COMBUSTIBILITY, FIRE, AND EXPLOSION SUPPRESSION IN A VARIETY OF ATMOSPHERES Final Report, 15 Nov. 1964–30 Dec. 1967
M. R. Stevens, H. D. Fisher, and B. P. Breen Wright-Patterson AFB, Ohio AF Aero Propulsion Lab. May 1968 103 p refs
(Contract AF 33(615)-2257)
(AFAPL-TR-68-35; AD-669349)

Combustibility studies of materials of construction employed in space flight vehicle cabins have been carried out as a function of various simulated cabin atmospheric environments. The program was conducted under three distinct phases. Phase 1 efforts were directed at defining the spontaneous ignition temperature, of the individual materials, under dynamic atmospheric conditions for the various atmospheres employed. Phase 2 centered about the burning characteristics of the respective materials as a function of atmospheric and gravitational environments. These studies also involve the effects of various extinguishants upon the burning characteristics under the influence of several atmospheric environments and gravitational variations. Phase 3 focused upon the flame spread behavior of the material, under the influence of various atmospheric environments and in the presence of Halon 1301 flame extinguishant. Detailed analyses of the work clearly show the dependency of the combustion behavior of the materials upon the atmospheric environment utilized. Author (TAB)

N68-30140# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATION OF DIFFUSION FLAMES [ISSLEDOVANIE DIFFUZIONNYKH PLAMEN]
Sh. A. Yershin and L. P. Yarin 15 Sep. 1967 42 p refs Transl. into ENGLISH from Prob. Teploenerg. i Prikl. Teplofiz. (Alma-Ata), no. 1, 1964 p 101–139
(FTD-MT-24-165-67; AD-669306)

The paper discusses the results of comprehensive theoretical and experimental studies of diffuse combustion in laminar and turbulent gas currents (jets). The study covered: (1) the combustion of unmixed gases within laminar plane-parallel boundary layers; (2) the combustion within plane-parallel boundary layers in the sub- and supersonic effluent velocity regions; (3) the combustion of axially-symmetrical and plane gas flames with given initial velocity (momentum), temperature, and concentration distributions; and (4) the combustion of axially symmetrical turbulent flames of finite dimensions spreading within a wake homogeneous current. The results confirmed the basic assumptions of the aerodynamic theory of gas flames, and the methods of the flow theory applied to the calculation of gas combustion allow the development of efficient approaches to the aerodynamic design of gas torches. The article also offers numerical results in the form of graphs and tables which may be utilized during engineering designs. Author (TAB)

N68-30143# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ANALYTICAL INVESTIGATION OF THE INFLUENCE OF VARIABILITY OF THERMO-PHYSICAL PROPERTIES OF LIQUID WITH TURBULENT NONISOTHERMAL MOTION IN TUBES [ANALITICHESKOE ISSLEDOVANIE VLIYANIYA PEREMENNOSTI TEPLOFIZICHESKIKH SVOISTV ZHIDKOSTI PRI TURBULENTNOM NEIZOTERMIZESKOM DVIZHENII V TRUBAKII]
L. I. Kudryashev and V. K. Lyakhov 28 Jul. 1967 23 p refs Transl. into ENGLISH from Tr. Kuibyshevski Aviats. Inst. (Kuibyshev), no. 15, 1963 p 225–226
(FTD-MT-24-115-67; AD-669418)

Semi-empirical methods are given for incorporating variable thermophysical properties in nonisothermal turbulent flows of various fluids. Derived expressions are applied to a number of flow situations. These include: heat transfer and skin friction for air at Pr approx. = 0.7; liquids such as oils under cooling and heating heat transfer; skin friction of liquids; and, finally, to conditions of near critical heat transfer conditions. All the results correlate well with experiments performed in tubes with the various fluids mentioned above. Author (TAB)

N68-30177# Catholic Univ. of America, Washington, D. C. Dept. of Mechanical Engineering.
NATURAL CONVECTION FROM HORIZONTAL RECTANGULAR CYLINDERS OF VARIOUS ASPECT RATIOS
Mahn Hee Hahn and David A. Didion 15 May 1968 27 p refs
(Contract Nonr-2249(12))
(TR-3; AD-669694)

An experimental investigation was conducted to determine the convective heat transfer coefficients for rectangular cylinders with various aspect ratios in air under atmospheric conditions. An empirical formula showing the correlation of the heat transfer coefficient with aspect ratio (height/half-perimeter) is obtained from the experimental data. Four models having the same perimeter were tested with aspect ratios varying from 1 : 8 to 7 : 8. The agreement between the empirical equation and experimental result for all the cases tested is within 5%. Author (TAB)

N68-30190* National Aeronautics and Space Administration, Washington, D. C.
CERTAIN GENERALIZATIONS IN THE THEORY OF ONE-DIMENSIONAL RADIATIVE HEAT TRANSFER [NEKOTORYYE OBOBSHCHENIYA V TEORII ODNOMERNOGO PERENOSA TEPLA IZLUCHENIYEM]
N. A. Rubtsov Jun. 1968 12 p refs Transl. into ENGLISH from Zh. Prik. Mekhan. i Techn. Fiz. (Moscow), no. 4, Jul.–Aug. 1967 p 66–73
(NASA-TT-F-11740) CFSTI: $3.00 CSCL 20M

The application of a simplified Boltzmann kinetic equation to the analysis of certain specific cases of one-dimensional radiative heat transfer is examined. The cases discussed involve both symmetric and asymmetric radiative heat transfer in plane layers of a gray non-dispersing medium and of media with uniformly distributed sources of heat emission. An integral equation is derived to

describe this one-dimensional radiative heat transfer. The solution of this equation indicates an appreciable effect of optical asymmetry on the distribution of the dimensionless value of the equilibrium radiation in such layers. Author

N68-30200# Centro Informazioni Studi Esperienze, Milan (Italy).
HEAT TRANSFER CRISIS WITH STEAM-WATER MIXTURES IN ROUND CONDUITS: REPRODUCIBILITY TESTS WITH DIFFERENT EXPERIMENTAL FACILITIES
A. Hassid, A. Milani, R. Ravetta, and L. Rubiera Brussels EURATOM May 1968 77 p refs
(Contract EURATOM-008-65-1 NTRI)
(EUR-3920.E) CFSTI: HC $3.00/MF $0.65

This report presents a comparison between heat transfer crisis data with vertical upward flow of steam-water mixtures in round tubes, obtained with different experimental plants. The experimental plants CISE IETI-2 and IETI-5 and SORIN high pressure facility are briefly described. The results, obtained with the same test element, are generally in good agreement, but under some conditions, still unexplained discrepancies are evident. This is in agreement with the observations made by other researchers, with both round ducts and rod bundles. The discrepancies are analyzed and a margin of uncertainty is derived for the critical power values. Author

N68-30206*# Michigan Univ., Ann Arbor. Dept. of Aerospace Engineering.
DETONATIONS IN TWO PHASE MEDIA AND DROP SHATTERING STUDIES Annual Progress Report, 1 Feb. 1967 – 31 Jan. 1968
E. K. Dabora, K. W. Ragland, and A. A. Ranger May 1968 129 p refs
(Contract NASr-54(07))
(NASA-CR-72421; UM-06324-5-T; APR-4) CFSTI: HC $3.00/MF $0.65 CSCL 21B

Recent experimental results on detonations in two phase mixtures of liquid fuel and gaseous oxygen are presented. The fuel (diethylcyclohexane) was in either a spray form or liquid film on the walls of the detonation tube. For the spray case three drop sizes were used. It is found that the smaller the drop size, the faster the detonation develops into a steady-state. Heat transfer measurements and inferred frictional losses to the walls are used in conjunction with a reaction length controlled by the breakup of the drops to arrive at a relationship that shows a direct dependence of velocity difference on the drop size. New photographs of the detonation phenomenon in a single stream of 2600μ drops show that the combustion in the wake of the drops results in explosions that feed the main front. Detonation velocities of a fuel film along one wall and two walls of the square tube are also lower than the ideal Chapman-Jouguet velocities. The velocity in the one wall case was lower than the two walls case even though the mixture ratio in the former was slightly higher. Some new results on the breakup of inert drops behind shock waves based on streak photographs are also presented. The photographs allowed a quantitative definition of the breakup time which seems to correlate well with previous, rather subjective estimates. An analytical treatment of the breakup phenomenon based on a boundary layer stripping model is made. Author

N68-30235 Michigan Univ., Ann Arbor.
THERMODYNAMIC PROPERTIES OF SOME CONDENSED POLYNUCLEAR AROMATIC COMPOUNDS AND SOME BICYCLIC GLOBULAR MOLECULES
Wen-Kuei Wong (Ph.D. Thesis) 1966 185 p
Available from Univ. Microfilms: HC $8.40/MF $3.00 Order No. 67-8380

The heat capacities of several polynuclear aromatic hydrocarbons (crystalline and liquid pyrene, fluoranthene, triphenylene, and perylene above 5°K., together with those of crystalline coronene and naphthacene) have been determined by adiabatic calorimetry from 5 to 350°K. Values of the heat capacities at saturated vapor pressure, enthalpy increments, entropies, and Gibbs energy functions were tabulated at selected temperatures. Heat capacities and thermodynamic properties of four bicyclic globular molecules, namely, bicyclo[2.2.2]octane (8-ane), bicyclo[2.2.2]octene-2 (8-ene), 1-azabicyclo[2.2.2]octane (QN), and 3-oxabicyclo[3.2.2]nonane (OXBN) were also determined from 5°K. into the liquid phase by adiabatic calorimetry. Dissert. Abstr.

N68-30291# Aeronautical Research Labs., Melbourne (Australia).
A COMPUTER PROGRAMME FOR THE THERMODYNAMIC DESIGN OF REGENERATIVE PEBBLE BED HEAT EXCHANGERS
Clare Burrage Dec. 1967 15 p refs
(ARL/ME-290) CFSTI: $3.00

The formulas describing heat transfer and pressure loss in regenerative pebble bed heat exchangers are well established. In order to design an efficient pebble bed heater to operate over a wide range of running conditions, it is necessary to examine the performance of a number of alternative heater designs over the range of operating conditions to establish the best combination of thermal and pressure loss performance. The resulting volume of computation necessitates the use of a digital computer. The present note describes manipulation of the basic equations to suit the requirements of computer calculation and records the FORTRAN program which has been developed for use on the C.D.C. 160-A computer. Author

N68-30300# Saab Aircraft Co., Linkoping (Sweden).
SEMI-DISCRETIZED TREATMENT OF THE EQUATION OF CONDUCTION OF HEATS IN SOLIDS. ONE-DIMENSIONAL LINEAR FLOW OF HEAT
Hermann Behrbohm Sep. 1967 77 p refs
(SAAB-TN-63)

The partial differential equation governing the one-dimensional conduction of heat in solids is semi-discretized by discretizing the space coordinate only, leaving time as a continuous variable. The complete and explicit solution is given for the system of ordinary differential equations into which the partial differential equation of conduction of heat is split by discretizing the slab of finite length into an arbitrary number of subintervals of equal length. Arbitrary temperatures, or fluxes of heat across the boundaries, or linear combinations of both, at the ends of the slab and variable with time, arbitrary initial temperatures along the slab, and arbitrary inner heat sources variable both in space and time, may be prescribed. The chosen system in toto, i.e., differential equation including the boundary conditions, is an approximation of the order $O((\Delta x)^2)$, where Δx is the width of the space meshes. The eigenvalues of the first, the second, and the mixed boundary value problem can be explicitly given. The eigenvalues of the third boundary value problem depending of course, on the coefficients of surface heat transfer have, however, to be calculated numerically. Comparisons are made between analytic solutions of the semi-discretized system of approximating equations and analytic solutions of the exact equation of conduction of heat solids, showing the high approximating qualities of the semi-discretization method. NSA

N68-30358 Missouri Univ., Rolla.
A STUDY OF SURFACE AND GEOMETRIC EFFECTS ON THE NUCLEATE BOILING OF LIQUID NITROGEN AND LIQUID ARGON FROM ATMOSPHERIC TO THE CRITICAL PRESSURE
Calvin Benson Cobb (Ph.D. Thesis) 1967 82 p
Available from Univ. Microfilms: HC $4.40/MF $3.00 Order No. 67-12016

A maximum heat flux correlation was derived for corresponding states liquids and subsequently verified by the data collected in this study as well as data presented in the literature. By applying this correlation, one can predict maximum heat flux values at high pressures from maximum heat flux values measured at low pressures; however, to apply the correlation it is necessary to have at least one maximum heat flux value and the saturation temperature at which it was determined. Contrary to existing correlations, it is shown that for any nucleate boiling heat transfer correlation to be truly general, it must include heat transfer surface and possibly geometric properties. Nucleate pool boiling heat transfer studies were conducted under varying conditions in heat transfer surface, geometry, and medium. Dissert Abstr.

N68-30387*# Techtran Corp., Glen Burnie, Md.
ON THE CHANGE OF HEAT TRANSFER INTENSITY THROUGH A DIELECTRIC IN AN ELECTRIC FIELD [OB IZMENENII INTENSIVNOSTI TEPLOOBMENA CHEREZ DIELEKTRIK V ELEKTRICHESKOM POLE]
I. Ya. Balygin Washington NASA Jul. 1968 3 p Transl. into English from Inzh.-Fiz. Ah. (Moscow), v. 4, no. 2, 1961 p 113–115
(NASA-TT-F-11848) CFSTI: HC $3.00/MF $0.65 CSCL 20M

As a result of experiments it is discovered that the rate of heat exchange of a metal bar with the outside medium through a dielectric decreases when a permanent external electric field is switched on. A physical explanation is given. Author

N68-30396# Institut Franco–Allemand de Recherches, St. Louis (France).
GUIDING AND FORMING OF DETONATION WAVES ALONG ALTERNATING EXPLOSIVE AND INERT SURFACES [GUIDAGE ET MISE EN FORME D'ONDES DE DETONATION LE LONG DE SURFACES ALTERNATIVEMENT EXPLOSIVES ET INERTES]
M. Defourneaux 7 Nov. 1966 73 p refs In French
(Rept.-12/66) CFSTI: HC $3.00/MF $0.65

Principal methods of generating detonation waves are discussed in relation to the phenomena of explosive–explosive or explosive–inert materials. A mathematical approach is used to examine the characteristics of generators composed of a ternary system consisting of two explosive fibers separated by an inert material which does not transmit the detonation. The fibers are arranged so that the detonation of each is independent of the adjacent fiber. The use of two distinct explosives is considered an improvement in certain cases. Transl. by M.G.J.

N68-30435# Institut Franco-Allemand de Recherches, St. Louis (France).
COMPARATIVE MEASUREMENTS OF TEMPERATURES AND HEAT FLUX DENSITIES OF INCENDIARY SUBSTANCES [VERGLEICHSMESSUNGEN VON TEMPERATUREN UND WAERMESTROMDICHTEN AN BRANDSTOFFEN]
H. W. Koch 10 Nov. 1967 28 p refs In German
(T-40/67) CFSTI: HC $3.00/MF $0.65

Various incendiary substances were studied for their combustion characteristics and their time-temperature sequences over and below the developing fire. Maximal fire dimensions were determined by photography and ground surface heat transfer measurements were obtained by improved methods. Calculated heat flux densities and ground heat transfer values were used to evaluated the practical application of the incendiary substances. Transl. by G.G.

N68-30518*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF CHAMBER PRESSURE, FLOW PER ELEMENT, AND CONTRACTION RATIO ON ACOUSTIC-MODE INSTABILITY IN HYDROGEN-OXYGEN ROCKETS
John P. Wanhainen, Charles E. Feiler, and C. Joe Morgan Washington Aug. 1968 35 p refs
(NASA-TN-D-4733) CFSTI: HC $3.00/MF $0.65 CSCL 21H

An experimental investigation of a 20,000-lb. (89-kN) thrust engine with a single coaxial-type injector was conducted to determine the effect of variations in chamber pressure, weight flow per element, and contraction ratio, by changing nozzle throat diameter, on tangential-acoustic-mode stability characteristics of hydrogen-oxygen rocket engines. These characteristics were evaluated by determining the hydrogen-injection temperature below which combustion was unstable. A correlation of the stability limits was obtained as a function of the variables investigated. The roles of various parameters were also interpreted according to the mechanism assumed in the response-factor model of this propellant combination. Author

N68-30617# RAND Corp., Santa Monica, Calif.
THE THERMODYNAMICS OF THE SILICON CARBIDE/SILICON-CARBON VAPOR SYSTEM
F. J. Krieger Apr. 1968 37 p refs
(Contract F44620-67-C-0015)
(RM-5592-PR; AD-670151)

An investigation of the thermodynamic properties of silicon carbide (SiC) over a range of temperatures up to 6000K and pressures up to 1000 atmospheres. Two sets of equilibrium composition equations are used--one representing a pure gas phase, the other a heterogeneous system of gas and condensed (solid) silicon carbide. The gas phase of the heterogeneous chemical system, like the homogeneous gas phase, comprises 25 gaseous silicon-carbide species. Tabulated summaries give computed values of volume, molecular weight, moles of gas, moles of solid SiC, density, enthalpy, energy, and entropy for silicon carbide at various temperatures and pressures. A conventional Mollier diagram is included in which specific enthalpy is plotted against specific entropy, with cross plots of temperature, pressure, and molecular weight in the pure gas region, and cross plots of temperature and moles of condensed SiC in the gas-solid region. Variation of sublimination temperature with pressure for silicon carbide and graphite is also shown. Author (TAB)

N68-30643# Instituto Nacional de Technica Aeroespacial, Madrid (Spain).
FLAME PROPAGATION OVER THE SURFACE OF A PLASTIC FUEL IN AN OXIDIZING ATMOSPHERE Final Report
C. Sanchez Tarifa, A. Munoz Torralbo, and P. Perez del Notario 1 Oct. 1967 43 p refs
(Grant AF-EOAR-42-66)
(AFOSR-68-1163; AD-670229)

A general theory of flame spreading over the surface of a solid fuel in an oxidizing atmosphere is developed in the work. This theory is of a general type and it covers flame spreading processes of very different nature. However, the theoretical study was directed to the case of flame spreading over the surface of plastic fuels in mixtures of nitrogen-oxygen and the experimental program is being carried out with these materials. With this orientation, the flame spreading process is of interest in connection with fires in spacecraft and it is also related to the problem of ignition in hybrid rockets. The process is studied by considering heating of the fuel by the flame through radiation and convection, heat conduction within the fuel, vaporization of the fuel and mixing with the gaseous atmosphere and flame propagation through this combustible mixture. An analytical solution of the problem is given which is obtained by solving in a simplified form the aforementioned

partial processes. The influence of pressure and composition of the oxidizing atmosphere as well as the initial temperature of the fuel is experimentally studied, and it is shown how these influences are being theoretically studied. Author (TAB)

N68-30646# Instituto Nacional de Technica Aerospacial, Madrid (Spain).
SOME FUNDAMENTAL PROBLEMS ON THE COMBUSTION OF LIQUID OXIDIZERS IN HYDROGEN
C. Sanchez Tarifa Mar. 1968 26 p refs
(Grant AF-EOAR-66-42)
(AFOSR-68-1165; AD-670187)

The object of the paper is the study of the basic process of combustion of single oxidizer droplets in a quiescent hydrogen atmosphere. There exists an abundant literature on droplet combustion. Most studies refer to the case of fuel droplets burning in air. Some studies consider more sophisticated fuels and there are a few studies on monopropellant droplets. On the other hand, no specific theoretical or experimental studies have been performed on the combustion of oxidizer droplets in hydrogen. This case cannot be included in a general theoretical study on droplet combustion owing to the specific properties of the hydrogen. Its low density and low molecular weight make diffusion conditions especially critical and the assumption of taking average values for gas density and for transport coefficients regardless of mixture composition, which is normally admitted in droplet combustion studies, may introduce important errors for the case of hydrogen and it is shown in the paper. Author (TAB)

N68-30654
NONSTATIONARY RADIANT HEATING OF A BODY OF CYLINDRICAL SHAPE
A. L. Burka [1968] 5 p refs Transl. into ENGLISH from Prikl. Mekh. i Tekhn. Fiz. (USSR), no. 2, 1968 p 76–80
CFSTI: HC $3.00/MF $0.65

Considered is the process of heating a cylinder whose upper base is subjected to radiant heating, and heat exchange to the ambient medium by Newton's law is accomplished on the rest of the surface. The mathematical formulation of the problem is described and used to analyze a particular case when the base of the cylinder is a heat insulator. S.C.W.

N68-30655
ANALYSIS OF NONSTATIONARY HEAT CONDUCTION OF MULTILAYER CYLINDERS
B. M. Avkhimovich 1968 5 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved. Aviats. Tekh. (Kazan), no. 4, 1967 p 54–58
CFSTI: HC $3.00/MF $0.65

Reported is an approximate solution of the heat conduction equation for an infinite multilayer cylinder. The applicability of the proposed approach in the solution of initial equations, and in the determination of the location of the heating front of a single layer continuous cylinder and a multilayer cylinder is discussed. S.C.W.

N68-30719*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THEORY OF LAMINAR FLAMES IN STAGNATION FLOWS
Raymond Kushida 15 Jul. 1968 13 p refs
(Contract NAS7-100)
(NASA-CR-95888; JPL-TR-32-1261) CFSTI: HC $3.00/MF $0.65 CSCL 21B

The theory of laminar flames sustained in a burner where combustibles are injected through two parallel, opposed porous walls is considered. For steady flow at low Mach numbers, similar solutions of the type found applicable to stagnation flow permit the reduction of the general equations of change to a set of one-dimensional equations. The classic one-dimensional flame equations of Hirschfelder are obtained in a limiting case where the rate of injection from one surface is just equal to the rate of suction at the other surface. Several examples of combustion experiments done in an apparatus which seems to approximate the ideal configuration have been previously reported. The flat flame diffusion burner of Pandya and Weinberg was the prototype burner on which the analysis was based. However, several other burners not previously recognized to exhibit similar solutions are pointed out. One example is the premixed flat flame burner in which there is flow divergence because of a screen of flat plate placed in the burnt gas flow. The experiments of Schultz where solid pellets are vaporized by pressing against a hot plate can be analyzed by this technique. Author

N68-30747*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
FLIGHT TEST ANALYSIS OF APOLLO HEAT SHIELD MATERIAL USING THE PACEMAKER VEHICLE SYSTEM
Randolph A. Graves, Jr. and William G. Witte Washington Aug. 1968 34 p refs
(NASA-TN-D-4713) CFSTI: HC $3.00/MF $0.65 CSCL 22B

The Apollo heat-shield material was flight tested on the hemispherically blunted nose cap of a Pacemaker vehicle. Ablation and temperature data were obtained at the stagnation point and at the 22.5°, 45°, and 67.5° stations. Maximum pressures at these locations were 8.4, 6.7, 4.1, and 1.7, atmospheres, respectively. (1 atm = 101 325 N/m^2.) Recession rates at the 22.5°, 45°, and 67.5° stations were greater than predicted, and this result is attributed to the high levels of turbulent aerodynamic shear, which exceeded the threshold shear sensitivity of this material. Unequal absorption of the surface sealer into the porous heat-shield material modified its behavior and introduced uncertainties in the analysis during the early portions of the data period. Author

N68-30762# National Aerospace Lab., Tokyo (Japan).
TRANSIENT HEAT TRANSFER THROUGH A THIN CIRCULAR PIPE DUE TO UNSTEADY FLOW IN THE PIPE
Nisiki Hayasi and Kenji Inouye Nov. 1967 10 p refs in JAPANESE; ENGLISH Summary Submitted for publication
(NAL-TR-144) CFSTI: HC $3.00/MF $0.65

An analysis of the transient heat transfer between a thin circular tube and the incompressible fluid moving through the tube is made for the case where the temperature of the inlet fluid is kept constant. Both radial conduction of heat in the wall and the heat loss at the outer surface of the cylinder are taken into consideration. It is shown to be especially easy to calculate temperature of both fluid and tube in the initial period by means of the figures attached to the previous report (NAL TR-53). So far, it is common to use the temperature of the wall calculated by the assumption that it is constant radially. It is shown that for the insulated tube in the initial period such temperature is equal to the temperature of the outer surface of the tube. The temperature of the inner surface of the tube may be appreciably different from such temperature even for the metallic tube. The difference is extremely large for the tube made of insulating material. Author

N68-30840# Aerospace Corp., El Segundo, Calif. Aerodynamics and Propulsion Research Lab.
ACTIVATION ENERGIES AND RATE CONSTANTS COMPUTED FOR THE COMBUSTION OF HYDROCARBON AND HYDROGEN FUELS
Stanley W. Mayer and LeRoy Schieler Mar. 1968 19 p refs
(Contract F04695-67-C-0158)
(TR-0158(9210-02)-3; SAMSO-TR-68-188; AD-669827)

A method is described for computing activation energies and rate constants of bimolecular combustion reactions of atomic

oxygen and molecular oxygen with hydrocarbon and inorganic fuels. The procedure is a modification of the transition-state bond-energy method previously applied in this series of investigations of rate data prediction for propellant performance and reentry nonequilibrium computer programs. Modification of the method was necessary in the investigation of combustion by O or O2 in order to include the effect of the triplet ground states on quantum-mechanical repulsion. The modified procedure provided much better agreement with experiment than did the method that neglects the triplet nature of ground-state O or O2. Computations of activation energies and rate constants were also made for combustion reactions of fuels with excited electronic states of oxygen that are likely to be more significant in high-temperature reactions. The excited states for which rate-constant computations are made for combustion reactions of fuels with excited electronic states of oxygen that are likely to be more significant in high-temperature reactions. The excited states for which rate-constant computations were made include O2(1)Delta-g), O2((1)Sigma-g(+), O((1)D), and ((1)S). Author (TAB)

N68-30856# North Carolina State Coll., Raleigh. Dept. of Mathematics.
BOUNDARY VALUE PROBLEMS FOR WEDGES AND CONES UNDER HEAT CONDUCTION
Charles A. Davis May 1968 65 p refs
(Grant AF-AFOSR-444-66)
(AFOSR-68-1042; AD-669835)

Mellin integral transforms and the Wiener-Hopf technique are used to obtain the temperature distribution in a semi-infinite wedge in which the temperature is specified on the boundary near the vertex and the remaining portion of the boundary is assumed to be insulated. Results are obtained in terms of infinite integrals. Several boundary value problems are considered for the semi-infinite cone. First, the temperature distribution is obtained for the problem where a constant temperature is specified for the portion of the surface of the cone near the vertex and the remaining surface is at zero temperature. Next, the problem is considered where a temperature, dependent only upon the radial distance r, is specified on the boundary. This latter problem was for the half space or cone of angle pi/2 and was solved using the Legendre transform of odd order. Finally, the mixed boundary value problem for the cone, analogous to that of the wedge above, is considered with the method of solution including the Mellin integral transform and the Wiener-Hopf technique. The results for the cone of general angle, 0 < alpha < pi, is in the form of an inversion integral. The temperature distribution is obtained as a residue series for the special case of alpha = pi/2. Author (TAB)

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents.

N68-29982*# New Mexico State Univ., Las Cruces.
PUBLIC BURDEN AND BENEFIT OF THE APOLLO PROGRAM ON LAS CRUCES, NEW MEXICO
Robert W. Beckstead Oct. 1967 28 p
(Grant NGR-32-003-027)
(NASA-CR-89946) CFSTI: HC$3.00/MF$0.65 CSCL 05C

A brief description of the major economic sectors that have influenced employment in Las Cruces is first presented. Public burden is defined as the operational and capital costs incurred by the local government when public services were provided, and public benefit is defined in terms of monies received by local government in taxes, licenses, federal aid, and state aid. The study covers the 1966 fiscal year and takes into account: number of employees, family size, number of school children, property assessment and mill levies, number of automobiles, miles driven in automobiles, consumption, federal and state aids to the Las Cruces school system, and the budgets of the city and the school district of Las Cruces. Overall the public benefit from the Apollo program is found to be greater than the public burden or cost by about 20%. K.W.

N68-30167# Oak Ridge National Lab., Tenn.
UNIT OPERATIONS SECTION Quarterly Progress Report, Apr.–Jun. 1967
M. E. Whatley, P. A. Haas, L. E. McNeese, A. D. Ryon, J. C. Suddath, et al May 1968 71 p refs
(Contract W-7405-ENG-26)
(ORNL-4204) CFSTI: HC$3.00/MF$0.65

Research progress is reported under the following topics: chemical engineering research, engineering separation of macromolecular biological substances, sol-gel process development, thorium fuel-cycle studies, power reactor fuel processing, fast-breeder reactor fuel processing, and molten-salt reactor processing. NSA

N68-30541# Joint Publications Research Service, Washington, D. C.
SOVIET-BLOC RESEARCH IN GEOPHYSICS, ASTRONOMY, AND SPACE, NUMBER 184
22 Jul. 1968 73 p refs
(JPRS-45946) CFSTI: HC$3.00/MF$0.65

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1. ASTRONOMY p 1–7 refs (See N68-30542 18-30)
2. METEOROLOGY p 8–26 refs (See N68-30543 18-20)
3. OCEANOGRAPHY p 27–36 refs (See N68-30544 18-13)
4. TERRESTRIAL GEOPHYSICS p 37–46 refs (See N68-30545 18-13)
5. UPPER ATMOSPHERE AND SPACE RESEARCH p 47–67 refs (See N68-30546 18-13)

N68-30727# Pennsylvania Univ., Philadelphia. Lab. for Research on the Structure of Matter.
[LABORATORY FOR RESEARCH ON THE STRUCTURE OF MATTER ANNUAL TECHNICAL REPORT, 1966–1967]
Louis A. Girifalco 30 Jun. 1967 256 p refs
(Contract ARPA SD-69)
(ATR-7; AD-670007)

Summaries are given of over 145 research projects active at LRSM during fiscal year 1967. The following general disciplines are represented: Basic chemistry and synthesis; structure of materials; kinetics and mechanisms; thermodynamics and mass transport; mechanical properties; defects and phase transformation; surface and thin films; electronic and magnetic properties; interaction with radiation; quantum mechanics and statistics. In addition, the facilities of the following research centers are briefly described: Analytical chemistry; Electron microscopy; High magnetic field; Instrumentation; Magnetic resonance; Mass spectrometry; Materials processing; Mechanical testing; Metallography; Microwave spectroscopy; Spectroscopy; X-ray diffraction. TAB

N68-30734# Library of Congress, Washington, D. C. Aerospace Technology Div.
FOREIGN SCIENCE BULLETIN, VOLUME 4, NO. 7
Jul. 1968 62 p refs

Reported is a monthly review of selected foreign scientific and technical literature on the following: analytic theory of motion of a space vehicle toward the moon; trends in the development of space psychology; a cultivator for continuous culture of microalgae; experiments in measurement of cosmic rays with artificial earth satellites; the feasibility of using superconducting devices in artificial earth satellites; determination of the chemical composition of the atmosphere of Venus by the Venera-4 interplanetary probe; the coherent accelerator; the power struggle in quantum electronics; separation of zirconium and hafnium; luminescence progress and applications; radiation chemistry of organic compounds; and comparative studies of satellite drag data with standard atmospheric models. S.C.W.

N68-30748# Congress. House. Committee on Science and Astronautics.

SUPPORT SERVICE CONTRACTING BY THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Washington GPO 1968 58 p Proc. before the Subcomm. on NASA Oversight., 90th Congr., 2d Sess., no. 5, 11 Jul. 1968

Support service contracting by NASA is reviewed in these proceedings before the subcommittee on NASA oversight of the House Committee on Science and Astronautics. Statements were made by Harold B. Finger, NASA associate administrator for organization and management, and by Lt. Gen. Frank A. Bogart (ret.), deputy associate administrator for management at the Manned Space Flight office of NASA. A supplement to the opinion of the General Counsel of the U. S. Civil Service Commission, on the legality of selected contracts at the Goddard Space Flight Center is included. Guidelines for making comparative cost analyses of support service contracts are developed, and the miscellaneous financial operations from the NASA financial management manual are included. Worksheets for contractor and in-house performance costs are reprinted, and explanations of the cost elements are made in each instance. Cost estimates for personnel involved in in-house research are discussed. M.W.R.

N68-30861# California Univ., Berkeley. Operations Research Center.

ON EXISTENCE OF WEAKLY MAXIMAL PROGRAMS IN VON NEUMANN GROWTH MODELS

William A. Brock Apr. 1968 20 p refs
(Contract Nonr-222(83); Grant NSF GP-7417)
(ORC-68-10; AD-670486)

The paper describes general models of economic growth. An optimality criterion is formulated. It is shown that there exist optimal programs under weak, economically meaningful assumptions. TAB

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